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No. 74

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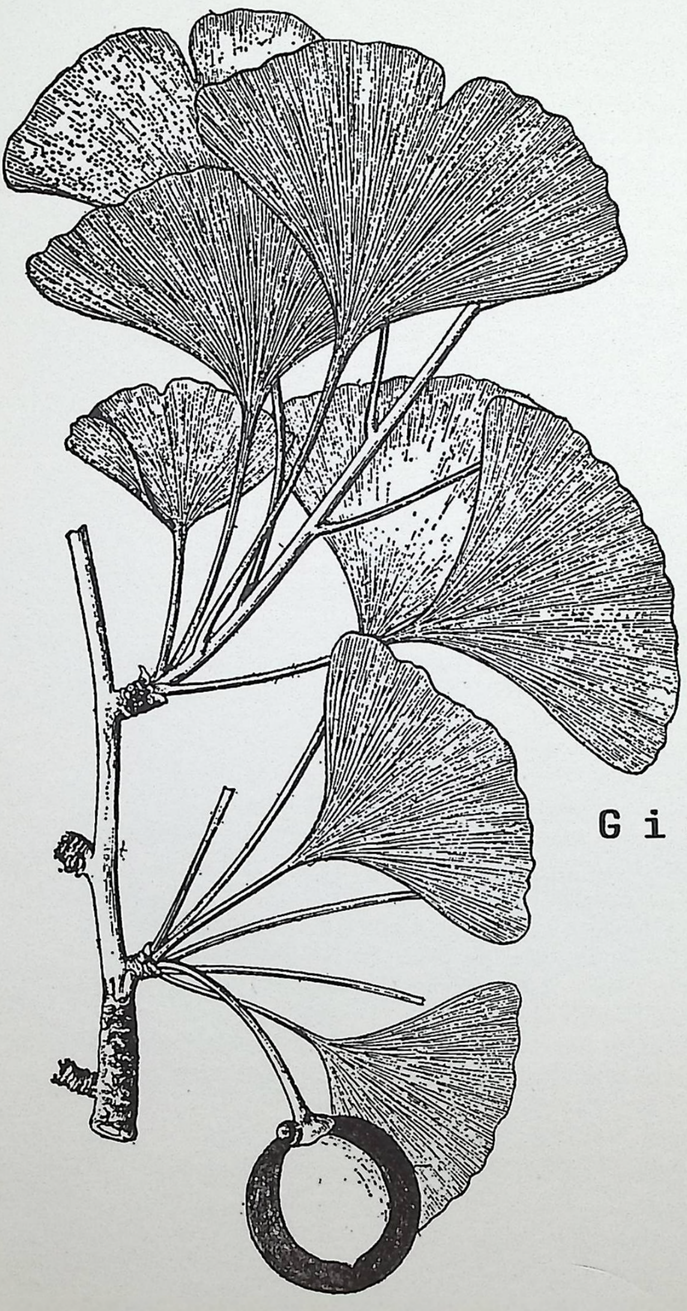
Anina - Jura

Aliveri - Miozän



Ginkgo geissertii

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Inhalt

Documenta naturae 74, p. 1-9, 4 text-figs, pls. 1-3, München 1992

THE EARLY LIASSIC OF ANINA: NEW PALEOBOTANICAL ASPECTS

by MIHAI POPA

1. Geographical situation:

The Anina locality is situated in the South-Western part of Romania (Caras-Severin County), in Banat Mountains area, 35 km South from Resita town. In some studies, it is known under the old name of the town, as Steierdorf (Text fig.1).

2. Geological characterisation of the area:

The sedimentary formation of Anina belongs to the Resita-Moldova Nouâ synclinorium, with the same tectonics and stratigraphy common for the whole structure. It is formed in the Hercynian cycle (Late Carboniferous, Early and Middle Permian) and in the Alpine cycle (Jurassic and Cretaceous). Structuraly, these layers are disposed in an anticline shape, oriented NNE-SSW, reversed through East, with limbs transversally and longitudinally faulted. In profoundness, tectonics are getting very complicated because the mechanical characteristics of the rocks are variating wihtin large limits.

The Lower Liasic includes a complex alternation of conglomerates and various granulated sandstones, refractary clay and coal, in Gresten facies. It ist comprising 8 coking coal seams situated in sandstone deposits and the paleobotanical material can be found in the sandstone beds or inside the sandstone lens trapped in the coal layers (Text fig.2).

The investigation was effectuated in Anina III West Area-Scale No. 1, Pit No. 1, the 8 th, 7/8 th and 7th Horizons, in the sandstone deposit situated between the coal seams No. 4 and 6 (in the area, the coal seam No. 5 is missing, being already pinchouted in North). In this zone, the layers have almost vertical strikes, being included in the Western limb of a strongly folded plunge anticline delimitated by the Zona Nouâ IA, II, III Faults and the Transversaly Fault No. 1 (Text fig. 3).

The local lithology means sandstone (prevailing), being a complex succession of centimetrical and decimetrical layers of fine granulated gray sandstone, with variations in the mica contents, coal seams, centimetrical or millimetrical coaly shales.

3. The history of Paleobotanical researches:

The paleobotanical contents of the Lower Liassic of Anina is remarkable. It is to be specified that the fossil plant distribution in situ has not been done before.
The fossil flora ist known since 1859 and the series of the researchers who contributed to its knowledge is the following:

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FOETTERLE (1850), ETTINGSHAUSEN (1852), ANDRAE (1855), STUR (1871 - a synthesis of the paleoflora), KRASSER (1921 - synthesis), THOMAS (1930), LANGER (1947), HUMML (1957, 1965), SEMAKA (1962, 1962a, 1965, 1970 - synthesis), GIVULESCU (1989, 1989A, 1990 - synthesis and systematical reconsideration).
Collections from Anina can be found in Bucharest, Cluj, Berlin, Budapest und Vienna. The research of this paleoflora was effectuated with two major disadvantages: the prelevation of the paleontological material was accomplished exclusivelly from the sterile deposits that are surrounding the exploitation and the taxonomical determination was generally done on morphological principles. Exceptions from this latter disadvantage are owed to Humml, Thomas and especially to Givulescu who utilisated successfully the Cuticular Analysis. Attempting to avoid the two disadvantages, the method was used when the conditions permitted it, like in the Sphenobaiera case, and also the material was prelevated from the underground working horizons.

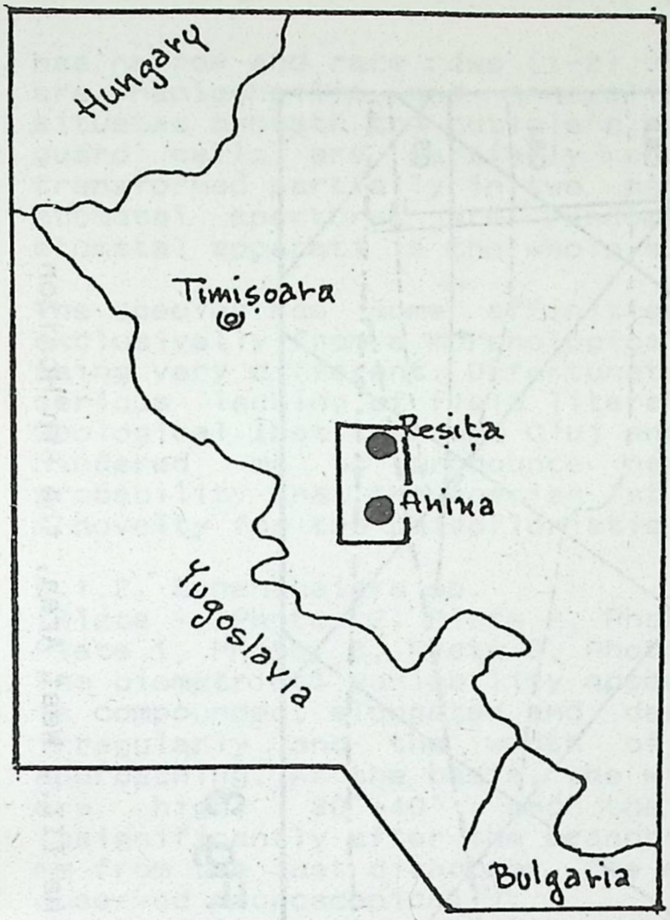
4. <u>The Cuticular Analysis:</u>
It presumes the treatment of the foliar material with a strong oxidizer (Schultze Reagent) for the reoxidation of the vegetal remains and for solving it, attempting to separate the upper and the lower cuticle. After neutralisation and intermediary washings, both cuticles are treated for microscopical study like all other usual biological material. The method permits a more restricitve differentiation, especially in the case of morphological convergencies. Used in combination with the macroscopical study, optimal results are obtained. In Romania the method remains a novelty, being not used in spite of its advantages.

5. <u>The paleofloristic association:</u>
It comprises taxa from:

Pteridophyta / Arthropsida / Equisetales, 2 species,
Filicopsida / Filicales, 21 species,
Gymnospermophyta / Pteridospermopsida / Cycadofilicales, 4 species,
Caytoniales, 3 species,
Cycadopsida / Bennettitales, 19 species,
Cycadales, 16 species,
Stachyospermopsida / Gynkgoales, 14 species,
Czekanowskiales, 7 species,
Coniferales, 19 species.

5.1. <u>The paleofloristic association studied. Description:</u>
5.1.1. Sphenobaiera sp., cf. spectabilis Florin
Stachyospermopsida / Gynkgoales / Gynkgoaceae
(Plate 1, Photo. 1, 5; Plate 2, Photo 1, 2)
Compound leaf, strongly dichotomically lobed and elongated lamina. 130 mm long, 3 mm wide at the basis of lamina that grows to 7 mm at the first dichotomical branching. There appear 4 such branchings successivelly at intervals of 10, 12 and 65 mm respectively. The length of the last segments is between 7-11 mm. Their dichotomy angles are small, 5°-7° for the first three branchings from the basis and 15°-20° for the last. The apical endings are not sharp but slightly rounded. Macroscopically, nervures cannot be observed.

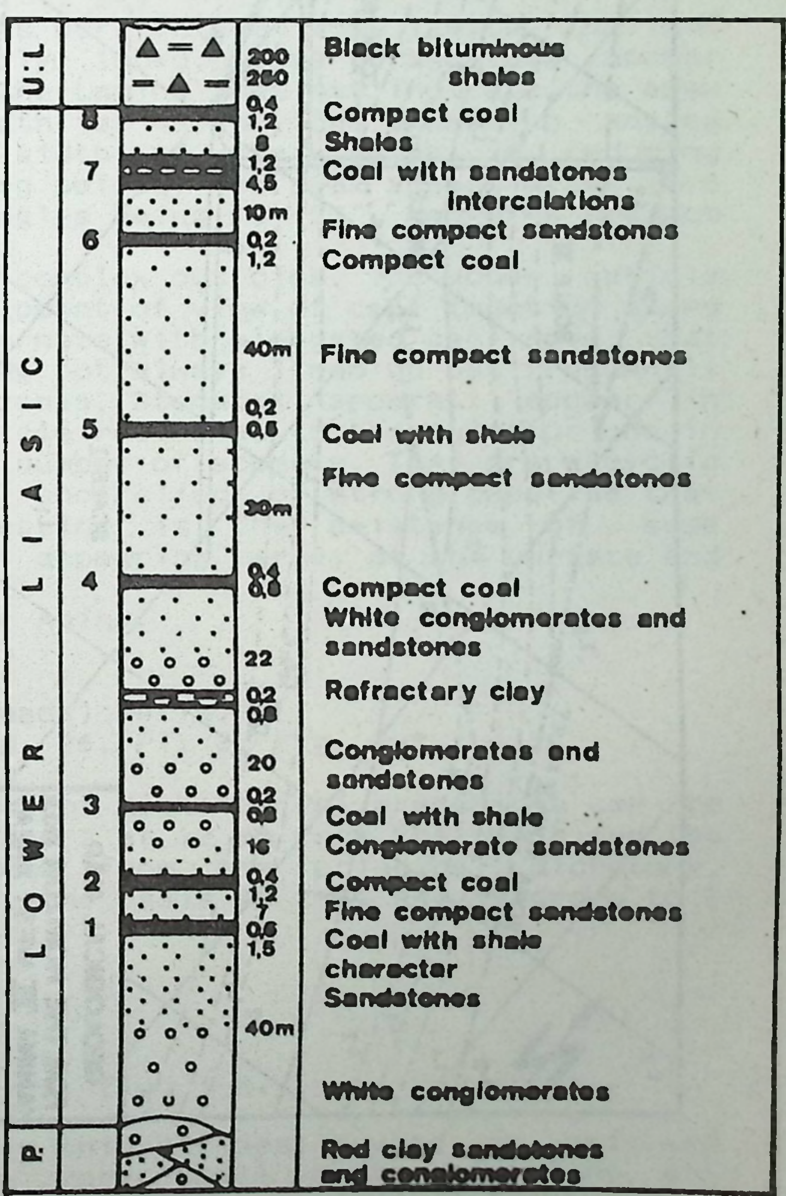
The leaf is hypostomatical und thin. The superior cuticle has well ordonated tabular cells and it is stomata lacking. The inferior cuticle comprises elongated cells disposed along the lamina und also



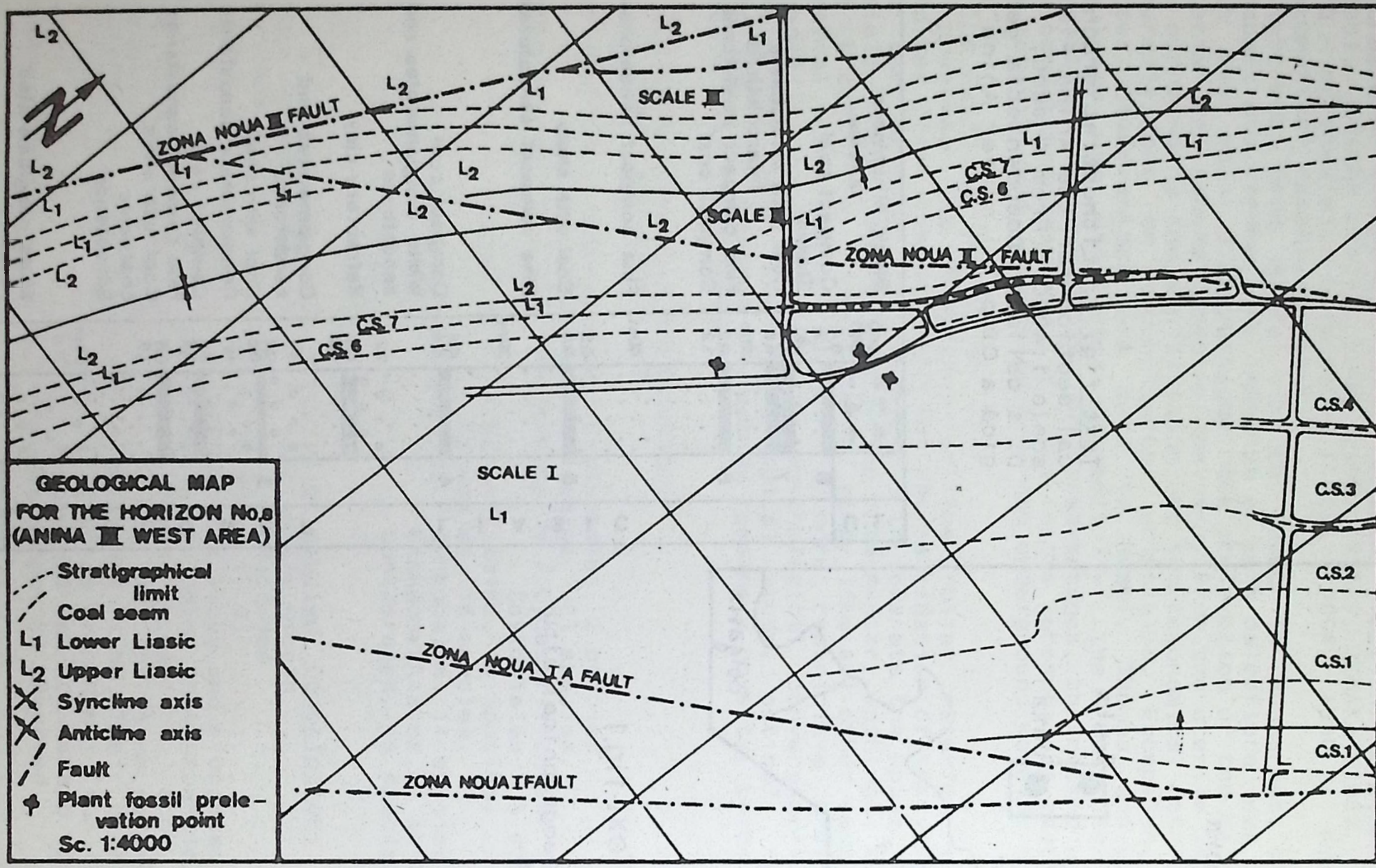
Text·fig.1

Text-fig. 1: Geographical situation of Anina.

Text-fig. 2: Lithostratigraphical section for the Anina Field, scale 1:4000. (From Anescu, D. & collab. "Documentatia geologică a Cîmpului minier Anina").



Text·Fig.2



Text – Fig. 3

Text-fig.3: Geologic. map of the Anina III., West Area, the 8th Horizon has narrow and rare rows (1-2) of tabular cells. The stomatal apparati are haplocheilic and moncyclic, with elongated guard cells that are situated beneath the cuticle's surface. The stomatal apertures and the guard cells are partially covered with tabular subsidiary cells transformed partially in two pairs of pappilae. The axis of the stomatal apertures are randomly oriented and the location of the stomatal apparati in the whole surface of the leaf ist chaotical.

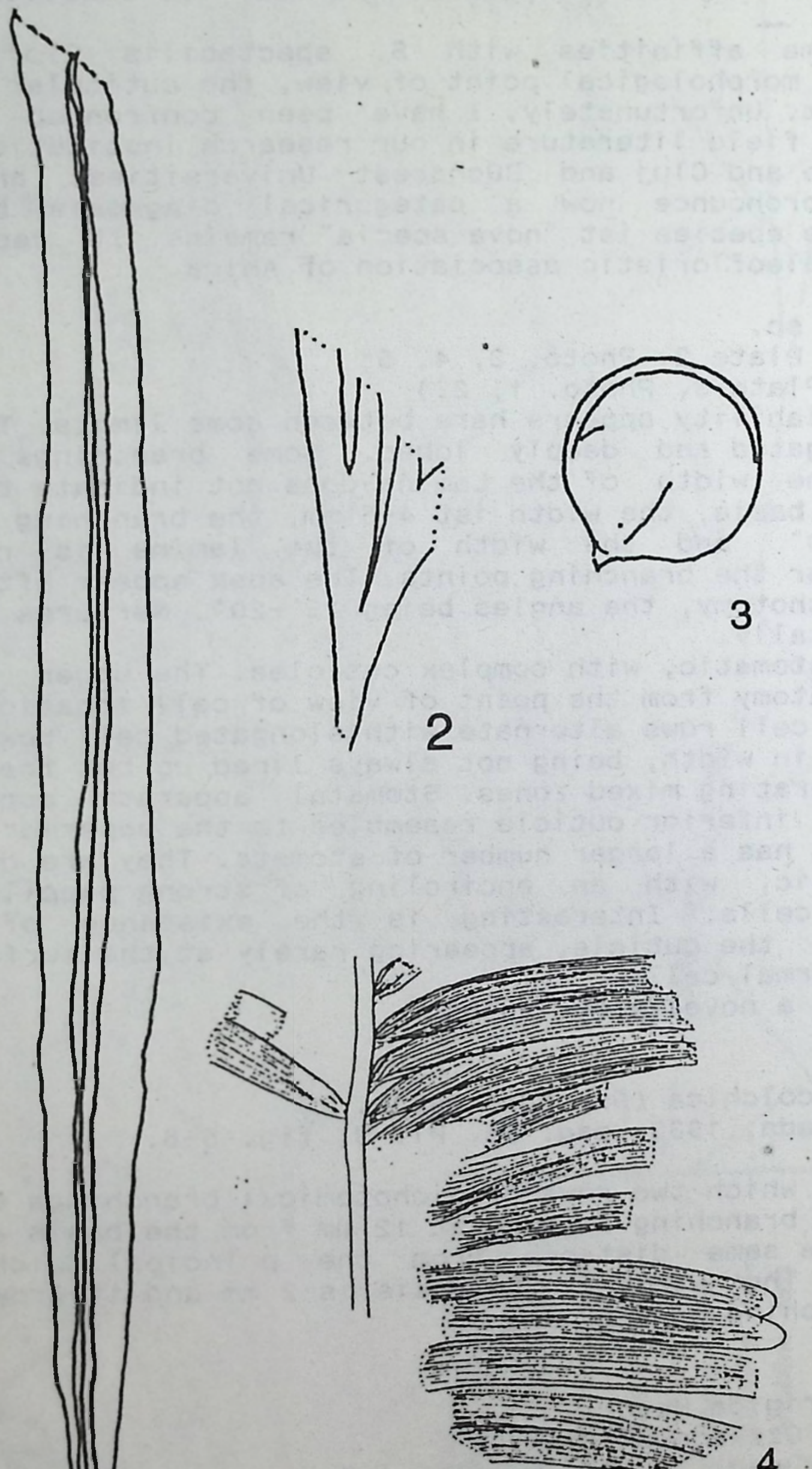
The species has some affinities with S. spectabilis Florin, but exclusivelly from a morphological point of view, the cuticular anatomy being very different. Unfortunately, I have been confronted with a serious lacking of field literature in our research institutions (The Geological Institute and Cluj and Bucharest Universities) and this hindered me to pronounce now a categorical diagnosis but the probability that the species ist "nova specia" remains. It represents a novelty for the paleofloristic association of Anina.

5.1.2. Sphenobaiera sp.
(Plate 1, Photo. 2, Plate 2, Photo. 3, 4, 5;
Plate 1, Photo. 3, Plate 3, Photo. 1, 2.)
The biometrical variability appears here between some limits. The leaf is compounded, elongated and deeply lobed. Some branchings appear irregularly and the width of the Lamina does not indicate the apex approaching. At the basis, the width ist 4-5 mm, the branching angles are high, 30°-40° and the width of the lamina is reducing insignificantly after the branching points. The apex appear after 5-6 mm from the last dichotomy, the angles being 15°-20°. Nervures are not observed macroscopically.
The leafs are amphystomatic, with complex cuticles. The upper cuticle has a variable anatomy from the point of view of cell zonation along the lamina. Tabular cell rows alternate with elongated cell rows that are not constand in width, being not always lined up but frequently curved and both generating mixed zones. Stomatal apparati appear in small number. The inferior cuticle resembles to the superior one in cell zonation but it has a larger number of stomata. They are dicyclic or rarely monocyclic, with an encircling of strong pappilae that covers the guard cells. Interesting is the existence of some circulary holes in the cuticle, appearing rarely at the surface and destroying the epidermal cells.
The species ist a novelty for Anina.

5.1.3. Sphenobaiera colchica (Prynada) Delle.
Baiera colchica Prynada, 1933, pag. 26, Pl. 3, fig. 5-6.
(Text fig. 4/2).
Reduced fragment, on which two rows of dichotomical branchings can be observed. The first branching appears at 12 mm from the basis and the secondary ones at the same distance from the principal dichotomy, being symmetrical. The width at the basis is 2 mm and it grows to 5 mm at the first branching.

5.1.4. Czekanowskia rigida Heer.
Stachyospermopsida / Czekanowskiales.
C. rigida Heer, 1876, pag. 70, Pl. 2, fig. 1-9.
(Plate 1, Photo. 4)
Compounded leafs extremely lobed in thin stripes, having an ondulate fascicle shape. 50-60 mm long, very small width of 1-2 mm, all stripes converging through a short theca with attaching role.

Text-fig. 4: Some plants of Liassic from Anina: 1. Nilssonia orientalis Heer, scale 1:2; 2. Sphenobaiera colchica (Prynada) Delle, natural size; 3. Carpolites sp., scale 1 x 20; 4. Pseudoctenis oleosa Harris, scale 1:2.



Text·fig.4

5.1.5 Pseudoctenis oleosa Harris.
Cycadopsida / Cycadales / Phyllospermopsidae.
From Doludenko, M.P., Svanidze, T, T. - "The Late Jurassic flora of Georgia", 1969.
(Text fig. 4/4).
Laminated leafs attached directly to the rachys which is also a symmetry axis for the whole branch, the laminae being stecked in opposed positions. They have lengths up to 85 mm, 8-9 mm wide, decreasing to the rachys attaching point. There appear 10-11 parallelly undivided nervures along the lamina. The rachys hat 5 mm width. The species represents a novelty for Anina.

5.1.6. Nilssonia orientalis Heer.
Cycadales / Nilssoniaceae.
N. orientalis, Heer, 1878, pag. 18, Pl. 4. fig. 5-9,
(Plate 3, Photo. 3, Text fig. 4/1)
Elongated lamina, variable length, between 170-250 mm, 7-8 mm wide at basis, 20-25 mm usually along the leaf and rounded apex. The central nervure ist bulky, from which secondary nervures start perpendicularly on the principal one. There are around 15-18 nervures / cm, being undivided themselves. The leaf inserts itself to the rachys with a short theca. In the sandstone that contains them, the leafs appear in a high density at the level of the 8th Horizon, where a spectacular accummulation appears.

The species is very frequent for Anina.

5.1.7. Carpolithes sp.
(Text fig. 4/3)
Subovoidal seeds, almost circular, small sized, 1-2 mm, with a sharp apical end. It frequently appears in the sandstone that contains Sphenobaiera, a novelty for Anina and the same literature lacking concerning it.

6. Acknowledgements.

I am grateful to Prof. R. Givulescu (University of Cluj-Napoca) and to Conf. O. Dragastan (University of Bucharest) for theirs precious help, to Dr. H.J. Gregor (Nature Museum of Augsburg) which accepted my note to be published. Many thanks to Mr. W. Malcherek (Institute of Geology, Ruhr Uni. Bochum) for the drawings.

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8. Plates

Plate 1:

Photo 1) Sphenobaiera sp., cf. spectabilis Florin, natural size.

Photo 2) Sphenobaiera sp., exemplary No. 1, natural size.

Photo 3) Sphenobaiera sp., exemplary No. 2, natural size.

Photo 4) Czekanowskia rigida Heer, natural size.

Photo 5) Lower cuticle of Sphenobaiera sp., cf. spectabilis Florin, X135.

Plate 2:

Photo 1) Lower cuticle of Sphenobaiera sp., cf. spectabilis Florin, X340.

Photo 2) Idem.

Photo 3) Lower cuticle of Sphenobaiera sp., exemplary No. 1, X135.

Photo 4) Upper cuticle of Sphenobaiera sp., exemplary No. 1, with circular perforation, X135.

Photo 5) Idem, X340.

Plate 3:

Photo 1) Lower cuticle of Sphenobaiera sp., exemplary No. 2, X135.

Photo 2) Idem, X340.

Photo 3) Nilssonia orientalis Heer, scale 1:3.

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Contributions to the Lower Miocene flora of Aliveri (Island of Evia, Greece)

by E. VELITZELOS, C. BUZEK & Z. KVACEK

Summary: A small collection of fossil leaf remains from the Lower Miocene complex above the coal seam has been described and compared with a florula obtained by washing of underclay from the same open pit at Aliveri (Greece). While the fruit flora shows a swampy environment, the leaf assemblage represents a warm-temperate subhumid mesophytic forest. The forest composition differs evidently from that of Central Europe in the Lower Miocene, which indicates a gradual development of climatic zones in the Neogene of Europe.

Zusammenfassung: Eine kleine Kollektion fossiler Blätterreste aus dem untermiozänen Komplex über dem Kohleflöz wird beschrieben und mit der kleinen Flora verglichen, die anhand von Schlämmproben aus dem liegenden Ton der gleichen Grube bei Aliveri (Griechenland) gewonnen wurde. Die Früchteflora repräsentiert einen sumpfigen Biotop, wogegen die Blätterflora einem wärmeren, temperierten subhumiden mesophytischen Wald entspricht. Die Waldzusammensetzung im Untermiozän von Griechenland unterscheidet sich grundsätzlich von gleichalten Wäldern Mitteleuropas, was auf eine allmähliche Entwicklung der Klimazonen im Neogen von Europa hinweist.

Contents:

1. Introduction

Neogene sedimentary fillings of the Aliveri-Kymi Basin extend across the central part of the Island of Evia in the SW - NE direction (see KATSIKATSOS

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et al. 1981). In the northernly situated coal mining district of Kymi (previously Kumi), a well diversified fossil flora was recovered in the last century and treated by several authors (BRONGNIART 1861; UNGER 1862, 1867; SAPORTA 1868, 1879; ENGELHARDT 1910; FRITEL 1921; see also PINNA 1989). Another site of fossil flora and fauna has been recently found in the southern part of the basin, where brown-coal has been worked in the open-pit Plakes, about 3 km NE of Prinias village at Aliveri (see VELITZELOS & GREGOR 1990). This is also the locality, where the fossil remains discussed below come from.

In the region of Aliveri, the following lithostratigraphical units can be recognized (from below): 1) a fluviatile sedimentary complex of the Marmarenia Formation, 2) a coal seam, 3) a lacustrine marl complex of the Plakes Formation, and 4) a conglomerate and sandstone fluviatile unit of the Elean Formation.
Plant remains occur in the coal seam and in a few levels in the lacustrine complex. Pollen (BENDA in BENDA & de BRUIJN 1982), seed, fruit, and charophyte remains (GREGOR in BENDA & de BRUIJN 1982, GREGOR 1983) were also described from the coal seam and the underclay in the open pit. Later on, additional carpological material was recorded in the basal level of the coal seam (VELITZELOS & GREGOR 1985, see also 1987). C. BUZEK collected a few small samples from the same level during his visit at this open mine in 1984. We were able to identify so far from this collection obtained by washing: *Glyptostrobus europaeus* (BRONGN.) UNG. (numerous fragments of twigs and some cones, cone scales and seeds), *Myrica ceriferiformoides* BUCEK et HOLY (a few endocarps), *Decodon globosus* (REID) NIKITIN (more than 20 seeds) and *Cladium oligovasculare* MAI in KNOBLOCH (a single specimen). The assemblage matches with that described by GREGOR (1983).

The underclay yielded also a rich vertebrate fauna, which has been treated by several studies according to groups (see e.g. de BRUIJN, van der MEULEN & KATSIKATSOS 1980; DOUKAS 1984; KLEIN HOFMEIJER & de BRUIJN 1988). The fauna was at first ranged into the zone MN 3 (KATSIKATSOS, de BRUIJN & van der MEULEN 1981) but in view of the well represented Cricetidae fauna it undoubtedly represents the zone MN 4 b, Ottnangian (see FEJFAR & SCHMIDT-KITTLER 1984; KLEIN HOFMEIJER & de BRUIJN 1988). This is in agreement with the correlation of the fruit and seed flora from the same level with the Ottnangian (to Karpatian) (GREGOR 1983, in BENDA & de BRUIJN 1982) and a hiatus need not be anticipated between the fauna and flora in question. The occurrence of gastropods which obviously have not been studied yet in detail can also be mentioned (a large plate of coaly clay with gastropod remains was exhibited in the headquarters of the coal mine during 1984).

The macroflora described below was recovered by E. VELITZELOS in the marls of the Plakes Formation. The first collection was made many years ago and yielded partly leaf compressions with carbonized tissue. In 1984 a project was initiated to attempt cuticular analysis and improve taxonomic treatment of this flora. Only small samples of carbonized lamina (the specimens nos. AE 1-36) mostly broken into pieces due to rapid dessication, were anatomically studied. Since then additional material has been obtained during last several years by E. VELITZELOS, but will be treated elsewhere. The macroflora is deposited in the collections of the University of Athens, Department of Geology and Palaeontology, the epidermal preparations at the Charles University, Palaeontological Department, Praha, and the carpological material mentioned above in the collections of the Czech Geological Survey, Praha.

2. Systematic part

Pinaceae

Pinus nodosa LUDWIG

Remark: See MAI & VELITZELOS (1992).

cf. Betulaceae

cf. *Carpinus betuloides* UNG.
pl. 6, Fig. 1

Description: A fragment of broadly cuneate leaf base, with the relatively stout midvein, secondaries craspedodrome and double serrate margin; fine serration formed by numerous and very sharp teeth; secondaries and their marginal branches enter marginal teeth; small pieces of carbonized leaf lamina preserved at the midvein without epidermal structure.

Remarks: The leaf appears to be a fragment of Betulaceae foliage (*Alnus*, *Betula*, *Carpinus*). The finer serration indicates *Alnus* rather than the other genera of the family. However, it can be compared with the leaves described as *Carpinus betuloides* UNG. from Kumi, namely with the larger specimens figured in UNGER (1867, pl. 2, fig. 30).

Material: A single specimen (AE 28).

Myricaceae

Myrica sp. 1
pl. 4, figs. 1-2; pl. 7, fig. 4; text fig. 1

Description: Leaves almost complete, lanceolate, more than 10 cm long and up to 2.5 cm wide, entire-margined; gradually narrowed towards the base and apex; venation camptodrome, middle to very strong; secondaries alternate, relatively slender to fine, rising at right or almost right angles, curved and/or forking at the margin (however, often hardly visible); intersecondaries seem to be present; higher order venation not visible; texture probably firm. Epidermal structure poorly preserved except for large multicellular peltate glandular hairs (ca. 60 µm across) with biserial stalks showing still oil content.

Remarks: Two leaves lying beside each other apparently of the same species. This type of large peltate trichomes full of secrets occur in the topotypical specimens of *Myrica lignitum* at Parschlug as well as elsewhere (KNOBLOCH & KVACEK 1976; KOVAR 1984).

Material: Two leaves (AE 10 a, b, with counterparts).

Myrica sp. 2
pl. 4, figs. 3-11; pl. 7, figs. 1-3; text figs. 2-4

Description: Leaves lanceolate to lorate, usually about 10 cm long, mostly entire-margined, rarely toothed at the margin; teeth not much large and regular; venation semicraspedodrome (toothed forms) or camptodrome (entire-margined forms), midvein very stout, secondaries alternate, relatively slender to fine, arising at nearly right to wide angles, often sinuous or zig-zag in course, and forking at the margin; main branches of the forks terminating in sinuses or teeth; intersecondaries present; higher-order venation, if visible, in the form of fine and more or less regular areolation developed; leaf texture rather firm to coriaceous; coalified rests of lamina disintegrated. Adaxial epidermis thinly cutinized, probably hairless, consisting of polygonal cells (7-12 µm across) with anticlines nearly straight. Abaxial epidermis poorly preserved, very fragmentary except for regions along veins. Cell form variable, either ordinary cells matching in size those of the adaxial side, occasionally with wavy anticlines, partly groups of small thickened cells (6-7 µm across). Stomata anomocytic, rounded oval, 13-14 x 10-13 µm in size, exceptionally preserved. The areas along veins covered with frequent, large hairs, surrounded by 1-3 circles of thickened ±isometrical tiny cells. Peltate multicellular glandular hairs 30-55 µm across with biserial stalks (ca. 6 x 8 µm in size) occasionally preserved. Rests of a hypodermis tissue partly preserved in submacerated samples.

Remarks: Referring of the most of the specimens to *Myrica* is evidenced by epidermal structure. Only the specimen AE 9b (pl. I, fig. 6) is without epidermis. The leaves of *Myrica* are obviously abundant fossils in the described flora. They vary in shape, generally from lanceolate to lorate forms. Beside serrate leaves, entire-margined ones also occur. The latter are much more slender (e.g. AE 1 - pl. I, fig. 10). The secondaries are better visible in the toothed forms than in the entire-margined leaves. Their texture must have been thick because the carbonized matter is still thick as well. UNGER (1867) described a large number of leaves of *Myrica* from Kumi (sub *Banksia solonis* and *Dryandroides hakeaefolia* etc.). However, the toothed forms differ from our material by coarser marginal teeth. Some specimens from our collection well compare with the leaf fossils from Turkey identified as *Myrica pseudolignitum* KR. & WEYL. (MÄDLER & STEFFEN 1979, pl. 3, figs. 1-2). Similar suit of forms has been described from the Early Miocene of Mallorca, mainly as *Myrica arenesii* by ARENES & DEPAPE (1956). In the epidermal structure, the leaves at hand differ from all the so far described fossil species of *Myrica* by frequent simple trichome bases, which match in form with those encountered in several Recent species, e.g. *M. pennsylvanica* Loiret. (cf. CHOUREY 1974). The peltate hairs are in average smaller than those in the common *M. lignitum* (UNG.) SAP. (cf. KNOBLOCH & KVACEK 1976; KOVAR 1984). Specific separation of this also morphologically characteristic form seems to be justified.

Material: 9 specimens (AE 1, 4, 9b, 16, 17, 19b, 21b, 26a, 32a).

<u>Fagaceae</u>

Quercus mediterranea UNGER
pl. 5, figs. 1-15; pl. 7, figs. 5-7; text figs. 5-7

1867 *Quercus lonchitis* UNG.; UNGER, p. 50, pl. 5, figs. 1-17, 21, 22
1867 *Quercus mediterranea* UNG.; UNGER, p. 52, pl. 6, figs. 1-22
?1867 *Nephelium jovis* UNGER, pro parte, p. 74, pl. 12, fig. 24

1867 *Celastrus persei* UNG.; UNGER, p. 75, pl. 13, figs. 7-9
1867 *Celastrus oxyphyllus* UNG.; UNGER, p. 75, pl. 13, figs. 10-11

Description: Leaves very variable in form, both slender and wider, broadly oval, oblong to longly obovate, up to 7 cm long and 3.5 cm wide, with obtuse to cuneate base and acute to acuminate or obtuse apex; leaf margin usually simply toothed, rarely entire (or revolute), teeth rather small and sharply pointed, usually corresponding to the secondaries; venation craspedodrome, probably to camptodrome in the entire leaf parts (venation poorly visible in this case); midvein stout, in the upper part more slender and in some cases slightly sinuous or zig-zag; secondaries distinct, approximately up to about 10 in number on either side of the midvein; alternate, not much closely spaced, arising at moderate to wide angles, almost straight; forking in the course towards the margin and together with the branches enter the marginal teeth. Higher-order venation poorly visible; tertiary veins (on the specimens AE 8b - pl. 5, fig. 1) irregular, simple or branched, somewhat sinuous; leaf texture rather firm or coriaceous.

Adaxial epidermis slightly cutinized, cell structure rarely preserved. Ordinary cells straight-walled, polygonal, (ca. 20-24 µm in lenght) with pitting on anticlines, hypodermis (in submacerated samples preserved) straight-walled, with cell size 4-10 µm.

Abaxial epidermis usually highly corroded, partly punctate-striate on outer surface, anticlines of ordinary cells rarely seen, straight. Stomata densely disposed, broadly oval to roundish (12-)14(-16) x (10-)13(-15) µm in size, with polar T-pieces, small oval pore, anomocytic (to partly actinocytic). Thickened heavily cutinized hair bases (of stellate trichomes?) about 15(-24 µm) across including one central cell and 5-6 radially disposed subtriangular isometric neighbouring cells thickly cutinized, sparsely on the veins, in some samples spread over the whole undersurface, in rare cases (AE 22a, 27a, 29b) only solitary bases on veins. Inconspicuous rounded rests (of serial glandular? hairs) about 8 µm across encountered in most samples.

Remarks: Especially specimens AE 7 (pl. 5, fig. 3) and AE 35 (pl. 5, fig. 2) well agree morphologically with those described under the name of *Quercus mediterranea* UNG. from Kumi (UNGER 1867). Along with these forms falling into the traditional forms of *Q. mediterranea* UNG., some slender forms have been identified as being conspecific on the basis of epidermal structure and differ from this concept. The specimen AE 2 (pl. 5, fig. 15) is an oblong to lorate, small entire-margined leaf. Its texture must have been coriaceous and the venation is hardly reflected in the impression. Another incomplete leaf and its counterpart (AE 29a and AE 21a - pl. 5, figs. 11-12) show forking of some secondaries and slight indication of marginal teeth. One form (AE 12 - pl. II, fig. 5) that is oblong and slender, also does not differ by its epidermis from the others and may belong as an extreme variant to this species. A lower part of a leaf (AE 27a, pl. 5, fig. 14) shows a cordate base and forking of some secondaries, which arise at wide angles.

The consistency of the epidermal structure throughout various leaf forms suggests that only a single variable species is represented. This idea occurred also UNGER (1867), who was able to separate broader and slender leaves only arbitrarily. None of the Recent species from among comparable xeromorphic oaks of the sections *Ilex* OERST. and *Suber* OERST. correspond in all details of leaf anatomy with the fossils at hand, although basic features, i.e. the type of pubescence and form of stomata are the same. The foliage of *Quercus ilex* L. and *Q. alnifolia* PORCH. is more densely hairy beneath, without hypodermal tissue, that of *Q. coccifera* L. and *Q. callirpinos* WEBB. is nearly hairless, also without hypodermis, all with finely undulating anticlines of adaxilar epidermis. The hypodermal tissue is developed in *Quercus suber* L. and *Q. phillyreoides* GRAY, the former matching in size and form of stomata and the straight-walled adaxial epidermis, except for densely hairy abaxial side. In none of the listed species a cuticular striation was noticed but this feature may be due to corrosions during fossilisation. The cupules previously described in the Kumi flora (sub *Nephelium jovis* UNG.) may belong to the same species.

Material: 16 specimens (AE 2, 7, 8b, 11, 14, 21a, 22a, 24, 27a, 29a (counterpart of 21a), 29b, 31, 33, 35, 36).

<u>Lauraceae</u>

Daphnogene polymorpha (A. BRAUN) ETTINGSHAUSEN
pl. 6, fig. 6-7

Description: Leaves lanceolate, about 5-7 cm long and 2 cm wide, triveined, entire-margined; venation imperfectly acrodrome, midvein stout, with a prominent suprabasal pair of primaries; short secondaries in the upper part of the midvein and marginal area of both primaries. Adaxial epidermis well cutinized, consisting of polygonal, mostly isometric cells 7-10 µm across with straight to slightly wavy anticlines. Abaxial epidermis fragmentary, very thinly cutinized, in submacerated samples showing roundish outlines of paracytic stomata (ca. 10 µm in length) with a very short pore. Simple trichome bases (ca. 3 µm across) sparse, hypodermis tissue poorly preserved. Mesophyllous lense-shaped secretory bodies common, 40-60 µm across.

Remarks: These leaves of common form and size are usually identified as *Daphnogene polymorpha* in Central Europe (KVACEK & WALTHER 1974). Such forms were also described under the name *Cinnamomum lanceolatum* (UNGER) HEER and *C. scheuchzeri* <u>HEER</u> from Kymi. Although the structure of the abaxial epidermis is poorly seen, the details preserved compare well with the characters of this species from other Neogene localities in Europe.

Material: 2 specimens (AE 6, 25a).

Laurophyllum sp. 1
pl. 6, figs. 4, 8-13

Description: Leaves lanceolate, longly petiolate, about 10 cm long, up to 2 cm wide, with attenuate apex and cuneate base; margin entire; venation camptodrome, secondaries thin-spaced, alternate, relatively slender, rising at moderate to narrow angles, markedly curved in course, evidently looping at the margin; intersecondaries sometimes present; higher-order venation rarely seen (AE 15 - pl. 6, fig. 13) in the form of very fine areolation with mashes of irregular shape and size; leaf texture must have been coriaceous.

Adaxial epidermis well cutinized, consisting of polygonal ± isometric cells rarely more than 5-8 µm across with prevailingly straight, thick anticlines. Abaxial epidermis mostly without cell structure preserved, corroded, exceptionally with traces of small stomata (about 10-12 µm long) or only of spindle-like stomatal ledges. Small simple trichome bases sparse. Mesophyllous secretory lens-shaped bodies up to 25 µm across, common.

Remarks: A few leaves of lauroid nature can be identified on the basis of epidermia. Due to poorly preserved details of the abaxial epidermis we refrain from establishing a more precise taxonomic status of this leaf form, which obviously belongs to the Lauraceae with thin abaxial cuticle (e.g. *Litsea*, *Persea* spp.).

Material: 6 specimens (AE 3, 13, 15, 20 (counterpart of 15), 18b, 30, 34).

Laurophyllum sp. 2
pl. 6, fig. 14; pl. 7, figs. 8-9; text figs. 8-9

Description: A fragment of an entire-margined leaf base without visible venation except the midvein and thin secondaries. Texture coriaceous. Adaxial epidermis well cutinized, consisting of polygonal, ± isometric cells 8 (-12) µm across, with mostly straight anticlines. Abaxial epidermis moderately cutinized, ordinary cells ca. 12 µm across with slightly wavy anticlines. Stomata paracytic, guardcell pairs oval 10-15 µm long with longly spindle-like pore and prominent narrow ledges, subsidiary cells parallel aligned to the guard cells, narrow to ± triangular, slightly darker. Simple trichome basis (ca.3 µm across) frequent. Mesophyllous secretory bodies rare, 30 µm across.

Remarks: The possibility that the above described fragment represents only a better preserved specimen of *Laurophyllum* sp. 1 cannot be excluded. More and better preserved material is needed to elucidate relationship of this entity.

Material: A single specimen (AE 5a).

cf. Leguminosae
pl. 6, fig. 5

Description: Almost complete oval leaflet about 3.5 cm long and 1.6 cm wide, entire-margined, somewhat asymmetrically developed, shortly stalked; midvein distinct, secondaries thin-spaced, about 8 in number and diverging in relatively wide angles (rather poorly seen); higher-order venation not visible. Epidermal remains without cell structure preserved.

Remarks: The specimen may represent a leaf or leaflet, which has apparently thin consistency. Although the venation is rather poorly seen, the general form suggests a remain of Leguminosae. The group was richly represented in the flora of Kymi (UNGER 1867), as evidenced by pods.

Material: A single speciment (AE 8a).

Dicotylophyllum sp. 1
pl. 6, fig. 15

Description: Incomplete broadly oblong, rather large leaf about 9 cm long and 3.5 cm wide, stalked (stalk 1.5 cm long); leaf margin very finely and sparsely serrate; venation craspedodrome to semicraspedodrome, midvein stout, secondaries distinct, but not much thick, in large number and relatively closely spaced, rising at right or almost right angles (in the upper half), curved proximally, looping or forking at the margin and entering the marginal teeth (or sinuses?); a few intersecondaries seen in the lower part of the leaf; higher-order venation not visible, except for a few tertiary branches in the marginal area in the left part; texture estimated as medium; small piece of epidermis from the leaf margin did not show any structure.

Remarks: A very interesting leaf form, the affinity of which is uncertain. In morphology (venation and serration) it is comparable with the foliage of *Salix*, but such affinity cannot be proved and more and better preserved material is necessary to elucidate the position of this species.

Material: A single speciment (AE 23a).

Dicotylophyllum sp. 2
pl. 6, fig. 16

Description: Incomplete small leaf, not much over 3 cm long, palmetely 3-lobed, with indication of additional basal lobes; lobes slender, the medial longer than lateral, entire-margined; base cordate to auriculate, apices acuminate; venation palmate, actinodrome, primaries preserved 3-4, completely up to 6-7, straight, diverging at moderate angles, basal ones somewhat recurved; higher-order venation poorly visible; leaf texture evidently fine; epidermis not preserved, coalified remains highly disintegrated, thin.

Remarks: According to the state of preservation the specimen in question was a leaf that must have been of fine consistency. The systematic position of it is not clear. In gross morphology some similarity with the leaves of *Sterculia* or *Sassafras* can be found. The leaves of *Hedera* differ in form and venation. Their texture is firm and cuticle thicker. Lauraceous nature is improbable because in the leaf mesophyll no secretory cells are seen.

Material: A single specimen (AE 9a).

Dicotylophyllum sp.
pl. 6, figs 2-4

Remarks: The leaves included in this entity represent fragments with poorly preserved epidermal remains, which cannot be reliably assigned to any of the preceding species.

Material: 3 specimens (AE 5b, 18a, 19a).

Explanation to the text-figures

Fig. 1: *Myrica* sp. 1, an isolated peltate glandular trichome, preparation no. AE 10b/1 (bar = 10 μm)

Fig. 2: *Myrica* sp. 2, adaxial and abaxial cuticle, preparation no. AE 12/1 (bar = 10 μm)

Fig. 3: *Myrica* sp. 2, peltate glandular trichome and two trichome bases on the abaxial cuticle, preparation no. AE 16/3 (bar = 10 μm)

Fig. 4: *Myrica* sp. 2, two glandular peltate trichomes on the abaxial cuticle, preparation no. AE 17/1 (bar = 10 μm)

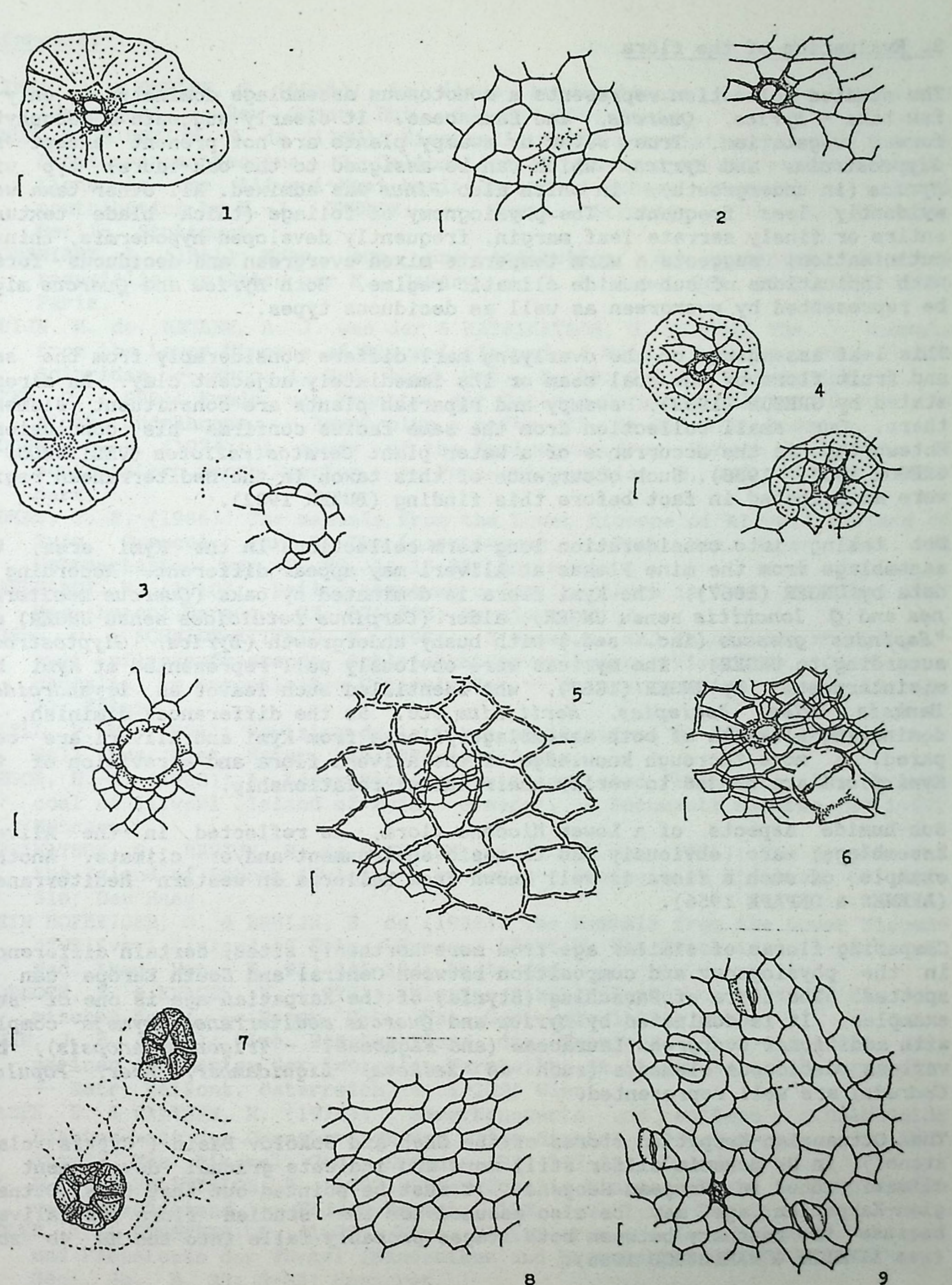
Fig. 5: *Quercus mediterranea* UNGER, adaxial epidermis with hypodermis, preparation no. AE 22a/1 (bar = 10 μm)

Fig. 6: *Quercus mediterranea* UNGER, abaxial epidermis with hypodermis, preparation no. AE 22a/1 (bar = 10 μm)

Fig. 7: *Quercus mediterranea* UNGER, two massive trichome bases, preparation no. AE 14/1 (bar = 10 μm)

Fig. 8: *Laurophyllum* sp. 2, adaxial cuticle, preparation no. AE 5a/2 (bar = 10 μm)

Fig. 9: *Laurophyllum* sp. 2, abaxial cuticle, preparation no. AE 5a/2 (bar = 10 μm)



Text-figures 1-9 (explanation see below).

3. Evaluation of the flora

The studied collection represents a monotonous assemblage dominated by only a few taxa - *Myrica*, *Quercus*, and Lauraceae. It clearly suggests a mesophytic forest vegetation. True water or swampy plants are not present except for *Glyptostrobus* and *Myrica*, which can be assigned to the oak-laurel typ with *Myrica* (in undergrowth), in which also *Pinus* was admixed. All other taxa were evidently less frequent. The physiognomy of foliage (thick blade texture, entire or finely serrate leaf margin, frequently developed hypodermis, thinner cutinisation) suggests a warm temperate mixed evergreen and deciduous forest with indications of sub-humide climatic regime. Both *Myrica* and *Quercus* might be represented by evergreen as well as deciduous types.

This leaf assemblage of the overlying marl differs considerably from the seed and fruit flora of the coal seam or its immediately adjacent clay. As already stated by GREGOR (1983), swampy and riparian plants are constituent elements there. Our small collection from the same facies confirms his conclusions. Noteworthy is the occurrence of a water plant *Ceratostratiotes* (VELITZELOS & GREGOR 1985, 1988). Such occurrence of this taxon in the Mediterranean region were anticipated in fact before this finding (BUZEK 1982).

Not taking into consideration long-term collections in the Kymi area, the assemblage from the mine Plakes at Aliveri may appear different. According to data by UNGER (1867), the Kymi flora is dominated by oaks (*Quercus mediterranea* and *Q. lonchitis* sensu UNGER), alder (*Carpinus betuloides* sensu UNGER) and "*Sapindus*" *graecus* (inc. sed.) with bushy undergrowth (*Myrica*, *Glyptostrobus* according to UNGER). The myricas were obviously well represented at Kymi but misinterpreted by UNGER (1867), who identified such leaves as *Dryandroides*, *Banksia*, *Olea*, *Asclepias*, *Neritinium* etc. So the differences diminish, if dominating elements of both assemblages/floras from Kymi and Aliveri are compared. A more thorough knowledge of the Aliveri flora and a revision of the Kymi flora are needed to verify their mutual relationship.

Sub-humide aspects of a Lower Miocene flora, as reflected in the Aliveri assemblage, are obviously due to mesic environment and/or climate. Another example of such a flora is well known from Mallorca in western Mediterranean (ARENES & DEPAPE 1956).

Comparing floras of similar age from more northerly sites, certain differences in the physiognomy and composition between Central and South Europe can be spotted. The flora of Parschlug (Styria) of the Karpatian age is one of such examples. It is dominated by *Myrica* and *Quercus mediterranea-drymeja* complex with additional evergreen Lauraceae (and Fagaceae? - *Trigonobalanopsis*), but various deciduous elements (such as *Zelkova*, *Liquidambar*, *Acer*, *Populus*, *Cedrela*) are well represented.

The Ottnangian-Karpatian floras of the Cheb and Sokolov Basin ("Cypris claystone") in NW Bohemia differ still more and indicate gradual development of climatic zones in European Neogene. It must be pointed out that this Ottnangian-Karpatian age may be also assumed for the studied flora of Aliveri because the boundary between both stages probably falls into the MN 4b zone (see ZIEGLER & FAHLBUSCH 1986).

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Explanation of plates

Plate 4

Myrica sp. 1

Fig. 1-2: almost complete leaves, AE 10a, b and counterpart; ca. x 1

Myrica sp. 2

Fig. 3: a large and well-preserved leaf, AE 4; ca. x 1

Fig. 4: probably a fragment of the leaf form AE 16 (pl. 4, fig. 7), AE 26a; ca. x 1

Fig. 5: a well-preserved serrate leaf, AE 32a; x 1

Fig. 6: an incomplete serrate leaf, AE 9b; x 1

Fig. 7: lower half of serrate leaf, AE 16; x 1

Fig. 8: a deformed, entire-margined leaf, AE 19b; ca. x 2

Fig. 9: an entire-margined leaf, AE 17; x 1.5

Fig. 10: very slender leaf form, AE 1; x 1

Fig. 11: an entire-margined leaf, AE 21b; x 2

Plate 5

Quercus mediterranea UNG.

Fig. 1: a smaller, incomplete leaf, AE 8b; x 1.5

Fig. 2: a large, incomplete leaf, AE 35; x 1

Fig. 3: a large oblong leaf, AE 7; x 1

Fig. 4: a large, almost complete leaf with branched secondaries, AE 22a; x 1

Fig. 5: a complete, longly ovovate leaf, AE 12; x 1

Fig. 6: a fragment of the small leaf, AE 33; x 2

Fig. 7: a smaller leaf with branched secondary vein, AE 24; x 1.5

Fig. 8: a small well-preserved leaf, AE 36; x 1.5

Fig. 9: an incomplete leaf, with sharp teeth, AE 31; x 1

Fig. 10: a very poorly preserved leaf, AE 14; x 1

Fig. 11: an incomplete leaf (a) and leaf fragment (b), AE 29a, b; x 1

Fig. 12: counterpart of the previous leaf (a), AE 21a; x 1.5

Fig. 13: a fragment of leaf, AE 11; ca. x 1.5

Fig. 14: lower part of wide leaf, AE 27a; ca. x 1.5

Fig. 15: a slender entire-margined leaf, AE 2; x 2

Plate 6

cf. *Carpinus betuloides* UNG.

Fig. 1: a fragment of the leaf, AE 28; x 1.5

Dicotylophyllum sp.

Fig. 2: lower part of a small leaf, AE 5b; x 1.5

Fig. 3: a fragment of the leaf, AE 19a; x 1.5

Dicotylophyllum sp. (a) and *Laurophyllum* sp. 1 (b)

Fig. 4: a lanceolate, entire-margined leaf without cuticle (a) and small leaf fragment with cuticle (b) right, AE 18a, b; x 1.5

cf. Leguminosae

Fig. 5: an incomplete leaf, AE 8a; x 1.5

Daphnogene polymorpha (AL. BR.) ETT.

Fig. 6: a longitudinally folded leaf, AE 25a; x 1.5

Fig. 7: an incomplete, common leaf form, AE 6; x 1

Laurophyllum sp. 1

Fig. 8: a wider form, AE 3; ca. x 1

Fig. 9: an incomplete leaf, AE 13; x 1

Fig. 10: a leaf without base and apex, AE 30; x 1

Fig. 11: a leaf with stalk, AE 34; x 1.5

Fig. 12: a leaf without apex, AE 20; ca. x 1

Fig. 13: lower part of the previous leaf, counterpart, AE 15; ca. x 1.5

Laurophyllum sp. 2

Fig. 14: a leaf fragment, AE 5a; x 1.5

Dicotylophyllum sp. 1

Fig. 15: a large, incomplete leaf with the stalk, AE 23a; x 1

Dicotylophyllum sp. 2

Fig. 16: a small, incomplete palmate leaf, AE 9a; x 2

Plate 7

Fig. 1-3: *Myrica* sp. 2
fig. 1: adaxial cuticle; fig. 2: trichome base; fig. 3: isolated glandular peltate trichome; x 500

Fig. 4: *Myrica* sp. 1 - isolated peltate trichome; x 500

Fig. 5-7: *Quercus mediterranea* UNGER
fig. 5: adaxial cuticle; fig. 6: abaxial cuticle; fig. 7 trichome base on the abaxial cuticle; x 500

Fig. 8-9: *Laurophyllum* sp. 2
fig. 8: adaxial cuticle; fig. 9: abaxial cuticle; x 500

(Inv. nos.: 1: AE 12/1; 2: AE 16/1; 3: AE 17/1; 4: AE 10b/1; 5: AE 22a/1; 6: AE 22a/1; 7: AE 14/1; 8: 5a/1; 9: AE 5a/1)

Documenta naturae 74, S. 26-31, 2 Abb., Taf. 8, München 1992

Ginkgo geissertii nov. spec. aus dem Pliozän des Elsaß, der Erstnachweis von *Ginkgo*-Samen im mitteleuropäischen Neogen

von H.-J. GREGOR

Summary: *Ginkgo geissertii* nov. spec. from the sandpit Kaltenhausen (Alsace) is the first find of a fossil *Ginkgo* seed in the European Neogen. It seems to differ from Recent *Ginkgo biloba* by broadly obovoid shape and obviously a dehiscing line beginning at the apex.

Résumé: Une espèce nouvelle de *Ginkgo* - *Ginkgo geissertii* - est décrite du Pliocène de la sablière de Kaltenhouse dans le Bas-Rhin. Les restes carpologiques fossiles sont confrontés avec ceux de l'unique espèce actuelle, *Ginkgo biloba*. Il s'agit de la première découverte faite dans le Néogène européen, où le genre n'était connu que par des fossiles foliaires.

Zusammenfassung: Aus dem Pliozän der Sandgrube Kaltenhausen wird eine neue *Ginkgo*-Art - *Ginkgo geissertii* - beschrieben, mit der rezenten *Ginkgo biloba* verglichen und im euroäischen Jungtertiär als Erstnachweis dargestellt.

Inhalt:

1. Einleitung

Die langjährige Zusammenarbeit der Autoren wurde 1990 durch die Übergabe einer neuen fossilen Art an das Naturmuseum Augsburg gekrönt. Herr GEISSERT hatte kurz vorher schon die August-Wetzler-Medaille (Günzburg) für seine Verdienste in der Wissenschaft überreicht bekommen und hat sich der Idee der selbstlosen Arbeit in paläontologischer Richtung mehr als würdig erwiesen. Er hatte im Fossilgut der Sandgrube Kaltenhausen im Elsaß erstmalig *Ginkgo*-Samen erkannt und Autor GREGOR zur Bearbeitung überlassen.

Anschrift des Autors:

Dr. H.-J. GREGOR, Naturmuseum Augsburg, Im Thäle 3, D-8900 Augsburg

Mein Dank gebührt Herrn GEISSERT, der für mich als Student bereits Lehrer war und mich in die Botanik, Zoologie und Paläobotanik des Elsaß einführte. Die neue Art soll ein Dankeschön für sein Engagement bei der wissenschaftlichen Erforschung des Elsaß sein.

2. Der fossile *Ginkgo*

2.1. *Ginkgo* LINNE - Gymnospermae

Ginkgo geissertii nov. spec.
Taf. 8, Fig. 1-7; Abb. 1-2

Synonym: 1990 Ginkgoaceae, GEISSERT, S. 27

Diagnose: Breiteiförmiger Same mit dünner Testa, apikalem Spitzchen und basalem Hilum mit Ringareal. Die glatte, leicht streifige Oberfläche zeigt nur wenige kleine Grübchen sowie verharzte Mantelreste (ehemals fleischig). Dehiszenzlinie umlaufend, apikal beginnend, in einer geknickten Ebene. Die Testa besteht aus 3 Schichten, wobei die äußere eine dünne Haut darstellt, die dicke mittlere aus sklerenchymatischen Längszellen besteht und die innerste ebenfalls wieder aus einer dünnen Haut.
Länge: 19 mm; Breite 16 mm;
Die äußere Form ist wie sonst heute auch 2(-3)kantig, aber aufgeblasen mit deutlichem Randwulst und Dehiszensnaht in 2 Ebenen.

Locus typicus: Kaltenhausen im Elsaß, Sandwerk SCHERER.

Stratum typicum: Pliozäne Tone, durch Greifbagger aus etwa 12 m Tiefe entnommen, vermutlich Unter-Pliozän aufgrund der Begleitflora (in Bearbeitung GREGOR).

Derivatio nominis: nach Herrn F. GEISSERT benannt, der 1990 als Erster die Zugehörigkeit des Fossils zur Gattung *Ginkgo* erkannte und die Unterschiede zur rezenten *Ginkgo biloba* L. klarstellte.

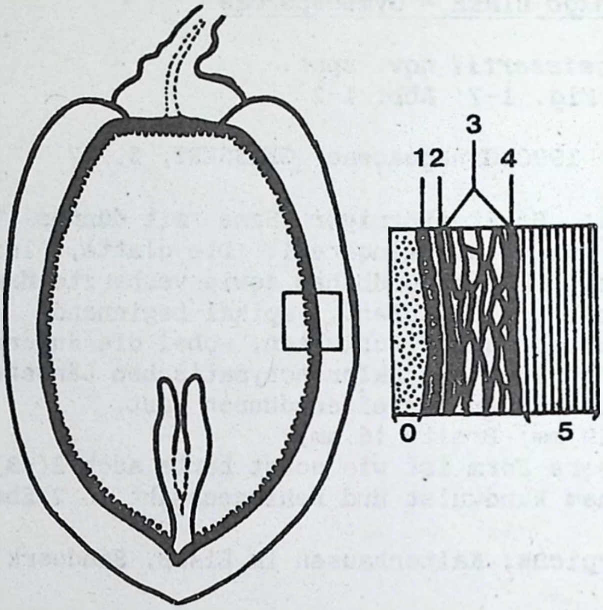
Holotypus: Inv.-Nr. 91-2128/534,
Aufbewahrung: Naturmuseum Augsburg, ex Coll. GEISSERT
(ein zweiter Same befindet sich in Coll. GEISSERT)

Rezente Vergleichsart: Es gibt bisher nur eine rezente Art - *Ginkgo biloba* L., die in China heimisch ist, allerdings in praktisch allen Fällen künstlich angepflanzt ist und heute z.B. auch in Japan vorkommt.

Morphologische Merkmale: Die rezente Art ist monotypisch, diözisch und hat steinkernartige Samen mit einem äußeren fleischigen Mantel (stinkend bei Verwesung, Taf. u, Fig. 13-14) und einer inneren, glatten, weißcremefarbigen, hornigen Steinschale (Taf. 8, Fig. 15-16). Diese Testa besteht wieder aus 3 Schichten: einer äußeren und einer inneren dünnen Haut und dazwischen sklerenchymatischen Zellen. Oftmals werden die fleischigen Samen als Früchte bezeichnet (Taf.8, Fig. 13,14 rechts). Das Endosperm füllt das Sameninnere ganz aus. In allen Punkten stimmt der fossile Samen mit den rezenten überein, bis auf die mehr aufgeblasene Form (vgl. Taf. 8, Fig. 1, 17) (vgl. zu allem Abb. 1).

Der anatomische Aufbau ist hier anders als in SCHOPMEYER (1974: 429) dargestellt. Größe und Form variieren bei den rezenten Samen von 14-20 mm Länge und 10-17 mm Breite (Taf. 8, Fig. 12, 16) und vor allem bei den Umrissen, die eiförmig, beidseitig zugespitzt (Taf. 8, Fig. 12 mitte) oder aufgeblasen (Taf. 8, Fig. 16 rechts), z.T. mit breiter Basis (Taf. 8, Fig. 17) sein können. Wichtig sind der meist vorhandene deutliche Randwulst mit Dehiszenznaht (Taf. 8, Fig. 15-16) und die meist in 1 Ebene liegende Dehiszenzlinie (Taf. 8, Fig. 16). Öfters kommt es zur Knickung der Dehiszenzlinie in Achsenrichtung des Samens. Meist liegt eine umlaufende Dehiszenz vor, zu einem gewissen Prozentsatz auch dreifache Dehiszenzausrichtung (Taf. 8, Fig. 15-16) (vgl. zu allem Abb. 2).

Abb. 1: Morphologie der Frucht von *Ginkgo biloba* mit Angabe der Teile 0 = Endosperm; 1 = innere Steinschale; 2 = innere Samentesta; 3 = sklerenchymatische Zellen der Samenschale; 4 = äußere Samentesta; 5 = fleischiger Mantel.



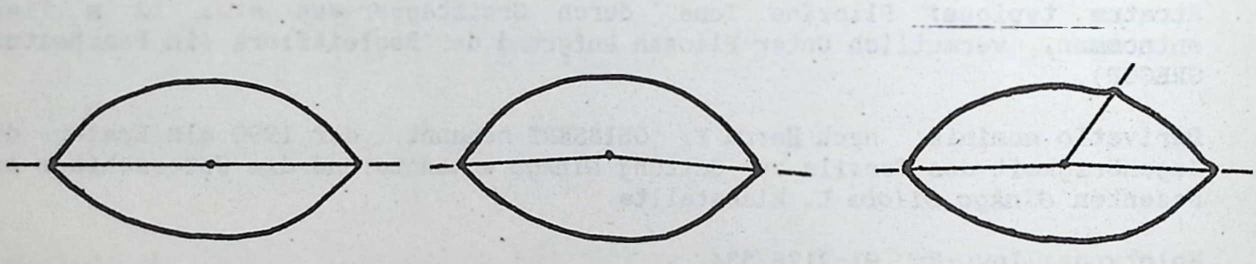


Abb. 2: Dehiszenzlinien bei rezenten *Ginkgo biloba*; 1 = gerade Ebene; 2 = geknickte Ebene in Achsenlinie; 3 = dreifache Dehiszenzlinien mit überall geknickten Ebenen.

2.2. Fossile *Ginkgo*-Reste

Fossile Ginkgogewächse sind seit langem bekannt und schon aus Kreide, Jura, dem Rotliegenden (Perm) und dem Karbon beschrieben worden (GOTHAN & WEYLAND 1973: 363-372), und zwar weltweit (HIRMER 1942: 421, vgl. auch VAKHRAMEEV et al., 1978).
Auch im osteuropäisch-asiatischen Bereich, im ehemaligen Rußland kommt *Ginkgo adiantoides* vor (KRYSHTOFOVICH 1935, HIRMER 1942: 510), so bei Stevli tomak (Baschkirien).

In Japan ist *Ginkgo* aus dem Eozän bis Unteren Oligozän bekannt (GRAHAM 1972, table 1), während KNOWLTON (1919: 301-304) eine Reihe von *Ginkgo*-Arten aus N-Amerika erwähnt, meist aus dem Jura, aber auch aus dem Eo-Oligozän.

Ginkgo-Reste sind schon früh aus diversen Tertiärablagerungen beschrieben worden, so z.B. aus der Grube Dora & Helene bei Groß-Zössen, aus dem hangenden Blätterton des Niederlausitzer Oberflözes, aus der Grube Fischbach bei Quadrath und aus den Klärbeckenschichten von Frankfurt a.M. (vgl. KIRCHHEIMER 1937: 33). Vor allem von letzterer Fundstelle erwähnt MÄDLER (1939: 46-48) schön mit Kutikeln erhaltene Blätter von *Ginkgo andiantoides* (UNG.) HEER. Aber auch Samen der selben Art teilt der Autor MÄDLER mit (ibid.) und bringt eine Synonymieliste seit 1887, vor allem von den Vorgängern der Klärbeckenflorenbearbeitung.

Nun zeigt ein Blick auf die Originalabbildung bei ENGELHARDT & KINKELIN (1908, Taf. 23, Fig. 16, 18), daß es sich bei der Form der Samen viel eher um solche von *Cephalotaxus* handelt (vgl. GREGOR 1979).
Da diese Reste aber alle im letzten Krieg verloren gingen, ist es müßig, die wahre Zugehörigkeit der Fossilien zu diskutieren - es gibt keine Beweise für *Ginkgo*-Samen vor dem Fund von Kaltenhausen.
Eine monographische Bearbeitung fossiler Ginkgoales hat TRALAU (1968) vorgenommen, die Synonyme gebracht, Datenlisten zur Phytographie und Stratigraphie und Literaturlisten zusammengetragen.

Aus den höheren Lagen des Miozäns, dem Pannon, nennt KNOBLOCH (1969: 60) Blätter von *Ginkgo adiantoides* aus Dubnany, SZAFER (1961: 13) ebensolche aus Stare Gliwice.
Auch in China kommt die Art *Ginkgo adiantoides* fossil vor. (Fossil Plants of China III, Cenozoic Plants of China, 1978, 7, Taf. 5, Fig. 4, Taf. 6, Fig. 4, 8, Taf. 7, Fig. 4.
In der Molasse fanden sich *Ginkgo*-Blätter in Geisenhausen, Lerch, Unterwohlbach, Breitenbrunn und Hilpoldsberg (vgl. GREGOR et al. 1989: 310-312 und GREGOR et al. 1992).

Die Wahrscheinlichkeit, daß Samen im Jungtertiär vorkamen, ist natürlich aufgrund der begleitenden Blätter gegeben gewesen - es sind aber niemals welche gefunden worden. Nun sind ganz besonders aus dem Elsaß Blätter von *Ginkgo adiantoides* zu beachten (vgl. GEISSERT 1972: 199, Abb. 7), die speziell aus Soufflenheim hervorragend mit Kutikularstruktur erhalten sind. Freundlicherweise hat der Finder und Bearbeiter, Herr GEISSERT (Sessenheim) die Funde an das Naturmuseum Augsburg gegeben, wo sie ausgestellt sind. Aus Auenheim teilte GEISSERT (1973: 213) die Art in Form von Blattfragmenten und Blättern ebenfalls mit.

3. Begleitflora

Der *Ginkgo*-Fund stammt aus einer fossilen Flora, die seit langem vom Kollegen GEISSERT zusammengetragen wurde. Es fanden sich deutlich exotische Formen wie *Corylopsis urselensis*, *Cyclocarya nucifera*, *Liquidambar magniloculata*, *Magnolia cor*, *Nyssa disseminata*, *Styrax maximus* und *Symplocos*-Arten, aber auch sehr gemäßigte Taxa wie *Alnus*, *Carpinus betulus*, *Corylus avellana*, *Fagus decurrens*, *Quercus* sp. und *Vitis teutonica*. Wasserpflanzen sind durch *Nuphar* sp., *Potamogeton* und *Ceratophyllum submersum*, Riedpflanzen durch *Epipremnites reniculus* und *Scirpus pliocaenicus* nachgewiesen (vgl. GÜNTHER & GREGOR 1989: 77; 1990: 37). Mit ihren 38 % exotischen und 29 % paläotropischen Anteilen ist die Flora von Kaltenhausen eher als unterpliozän einzustufen und ist sicher als Mixed-Mesophytic Forest anzusprechen.

4. Rezentvergleiche

Es gibt heute nur 1 Art der Gattung *Ginkgo* L. - *Ginkgo biloba* L.. Die Art ist aus Ost-Asien bekannt, aus China, Japan, Korea und der Mandschurei - meist nur im kultivierten Zustand (Tempelbaum, Straßenbaum). Ab 1727 war die Art auch als Parkbaum in Europa eingeführt (vgl. zu allem KRÜSSMANN 1983: 130-132). Nur aus Chekiang dürften natürliche Belege der Art vorliegen (ibid. Abb. 74). WANG (1961: 101, 106, 118) nennt die Art aus den Mixed Mesophytic Forests Tienmu-Shans (Lower Yantze Valley) und entland der Grenze zwischen Chekiang und Anhwei, in den Laungtungkou- und Hanchiakon-Tälern (Wuchnan-Hsien), in N' Chekiang und E' Kweichow, zusammen mit einer reichen warm-temperaten Begleitflora (*Sassafras*, *Nyssa*, *Schima*, *Liriodendron*, *Magnolia*, *Eurcommia*, *Catalpa* u.v.a.).

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6. Tafelerklärungen

Tafel 8

Fig. 1-8: *Ginkgo geissertii* nov. spec.
Kaltenhausen im Elsaβ; Unterpliozäne Tone
Inv. Nr. 91-2128/534 im Naturmuseum Augsburg. - Holotypus

Fig. 1: Exemplar mit gröβter Breite in Mitte oder leicht darüber; x 5

Fig. 2: von der Seite mit Dehiszenznaht; x 5

Fig. 3: von oben mit geknickter Dehiszenzlinie und links deutlichem Randwulst; x 5

Fig. 4: von unten mit basaler Ansatzstelle; x 5

Fig. 5-7: gleiches Exemplar von 2 Seiten und von oben; x 1

Fig. 8: Ausschnitt aus 4, längliche Zellstruktur der Testawand zeigend, x 10

Fig. 9-16: *Ginkgo biloba* L. - Rezente Früchte und Samen; Bot. Garten Freiburg

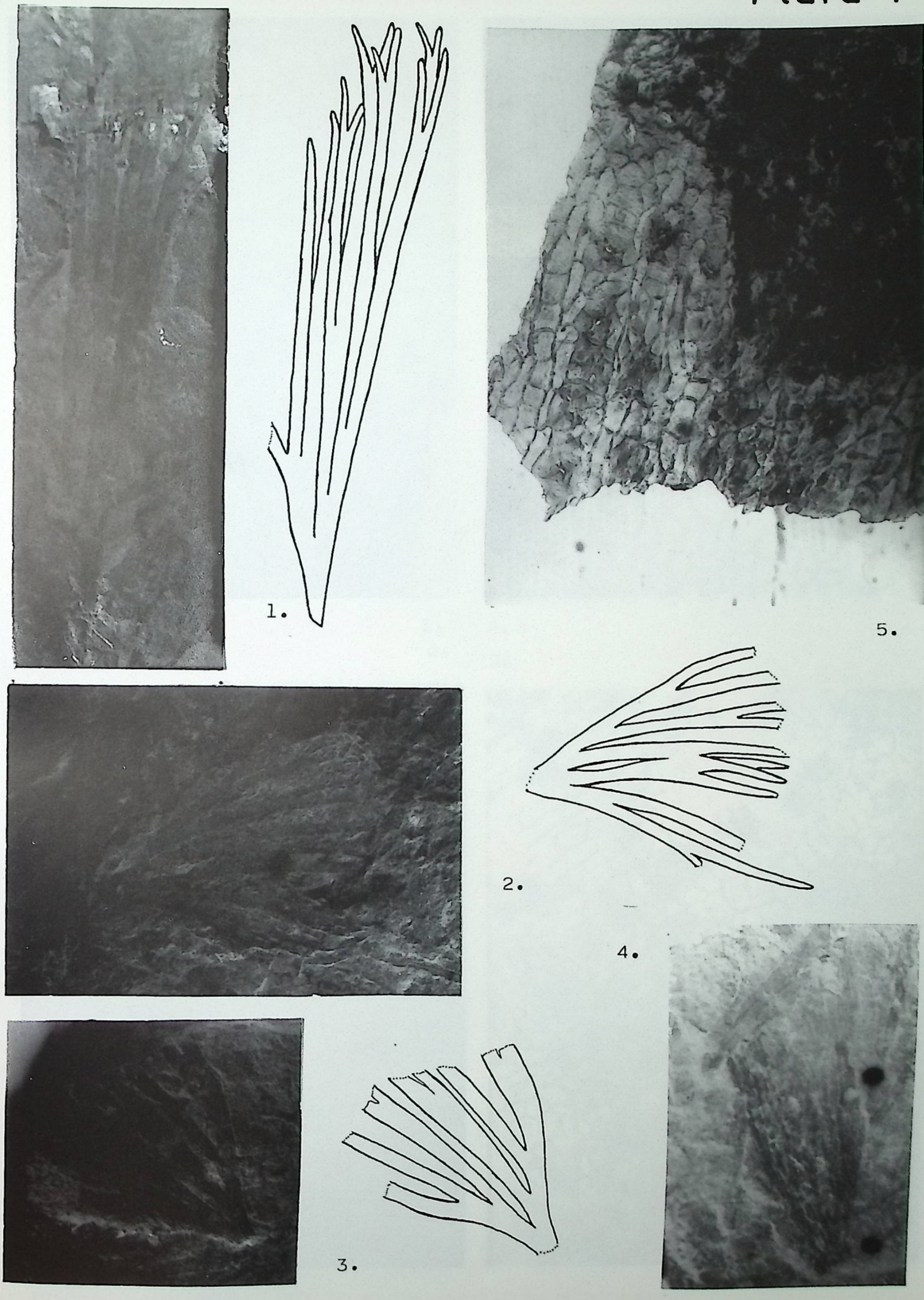
Fig. 9-10: Testawand im Querbruch - Vergleich zu Fig. 8, mit länglichen sklerenchymatischen Zellen; Fig. 9: x 10; Fig. 10: x 4

Fig.11-12: Rezente Samen von seitlich und von oben, Dehiszenz in gewinkelter Ebene zeigend; x 1

Fig.13-14: Samen mit Mantel und ganze Früchte, von seitlich und von oben, x 1

Fig.15-16: Samen von seitlich und von oben, Randwulst und Dehiszenz sowie typische Formen zeigend. Dehiszenzlinie in 1 Ebene bzw. in 3 Ebenen aufspaltend; x 1

Plate 1



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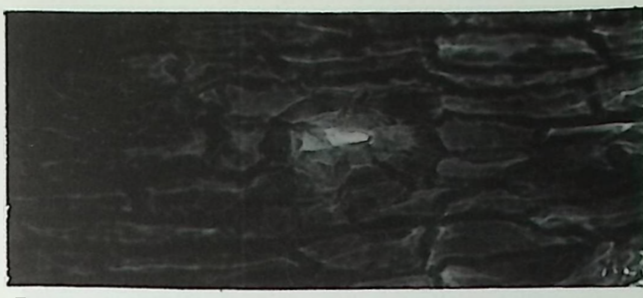

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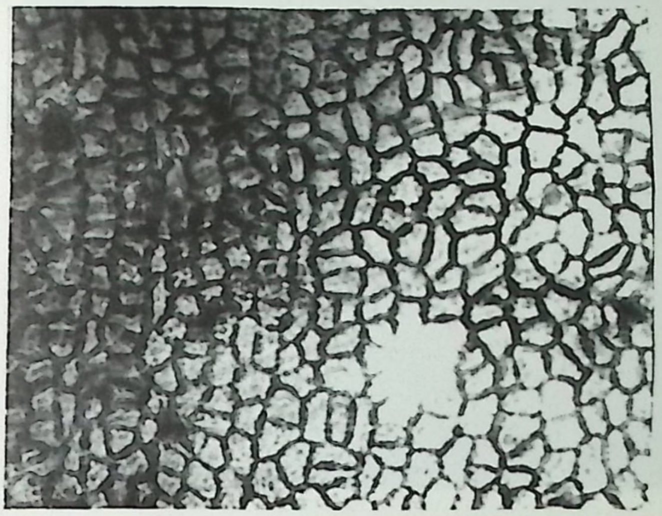


1. 4.

2. 3.

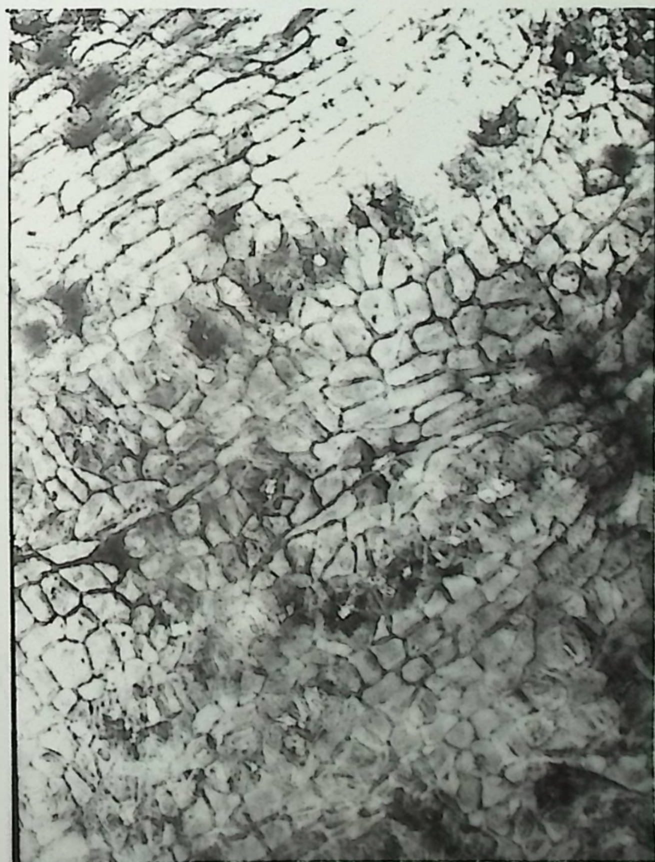
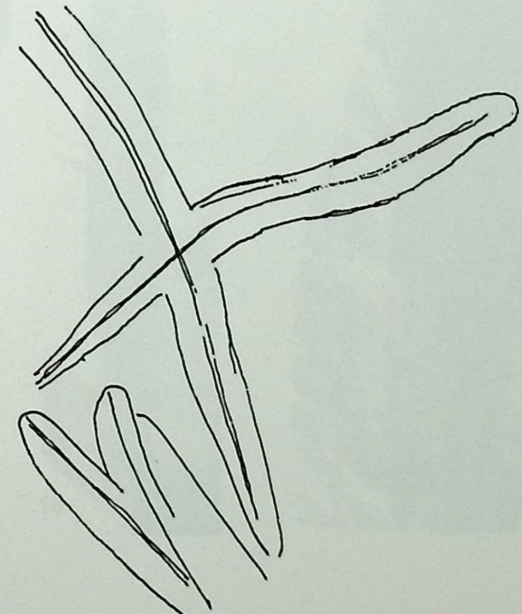


Plate 3

1. 2.

3.



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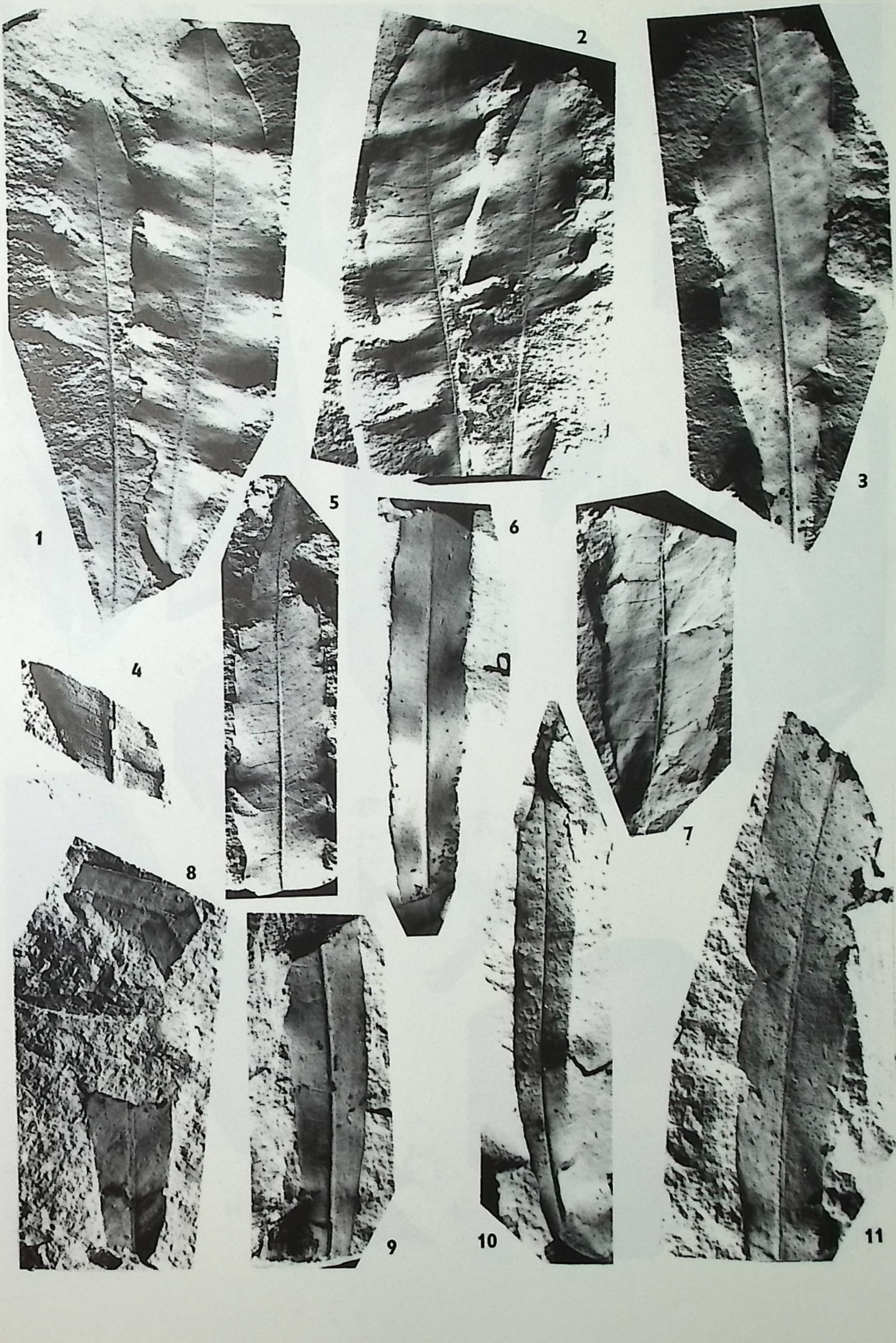

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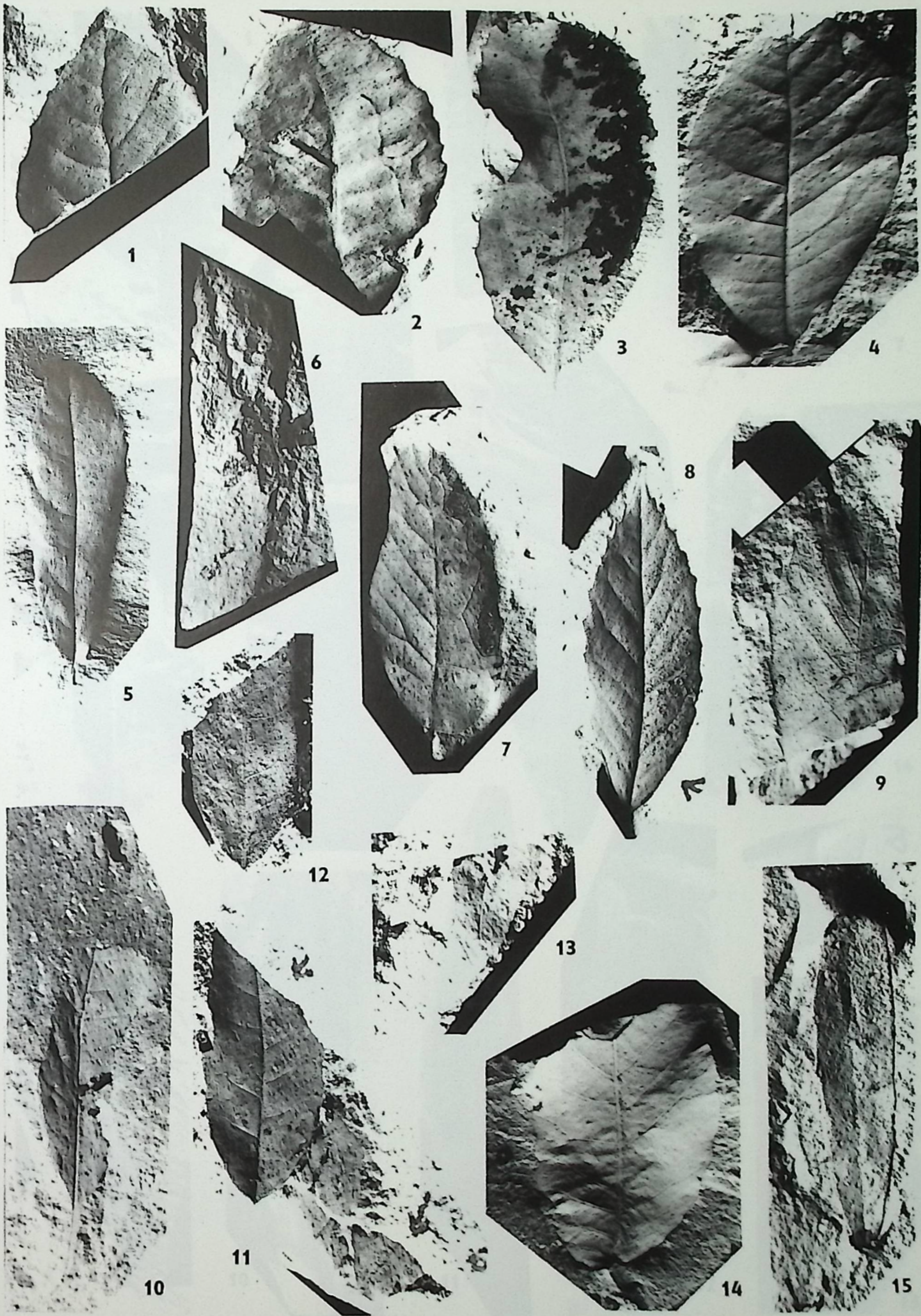

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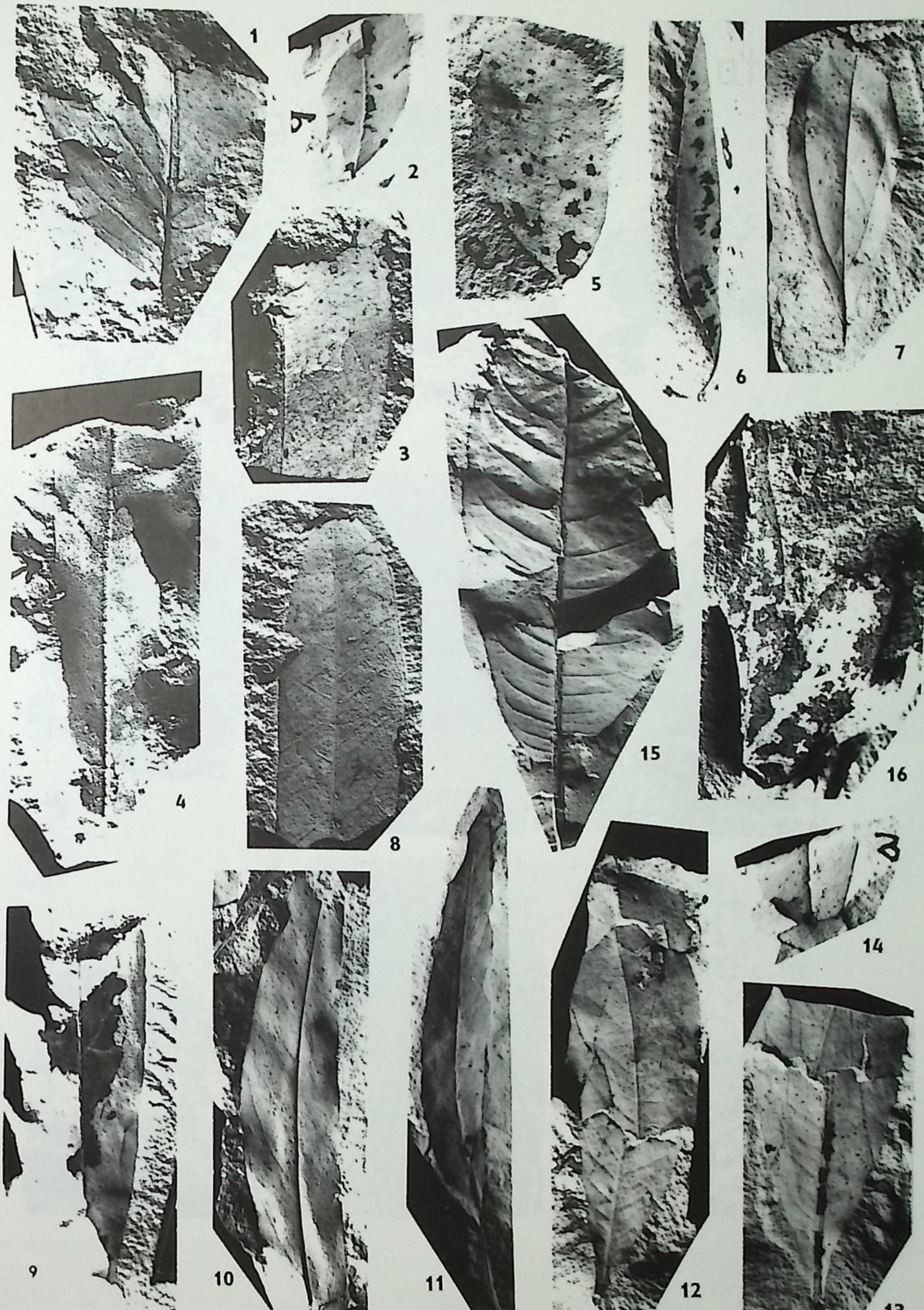
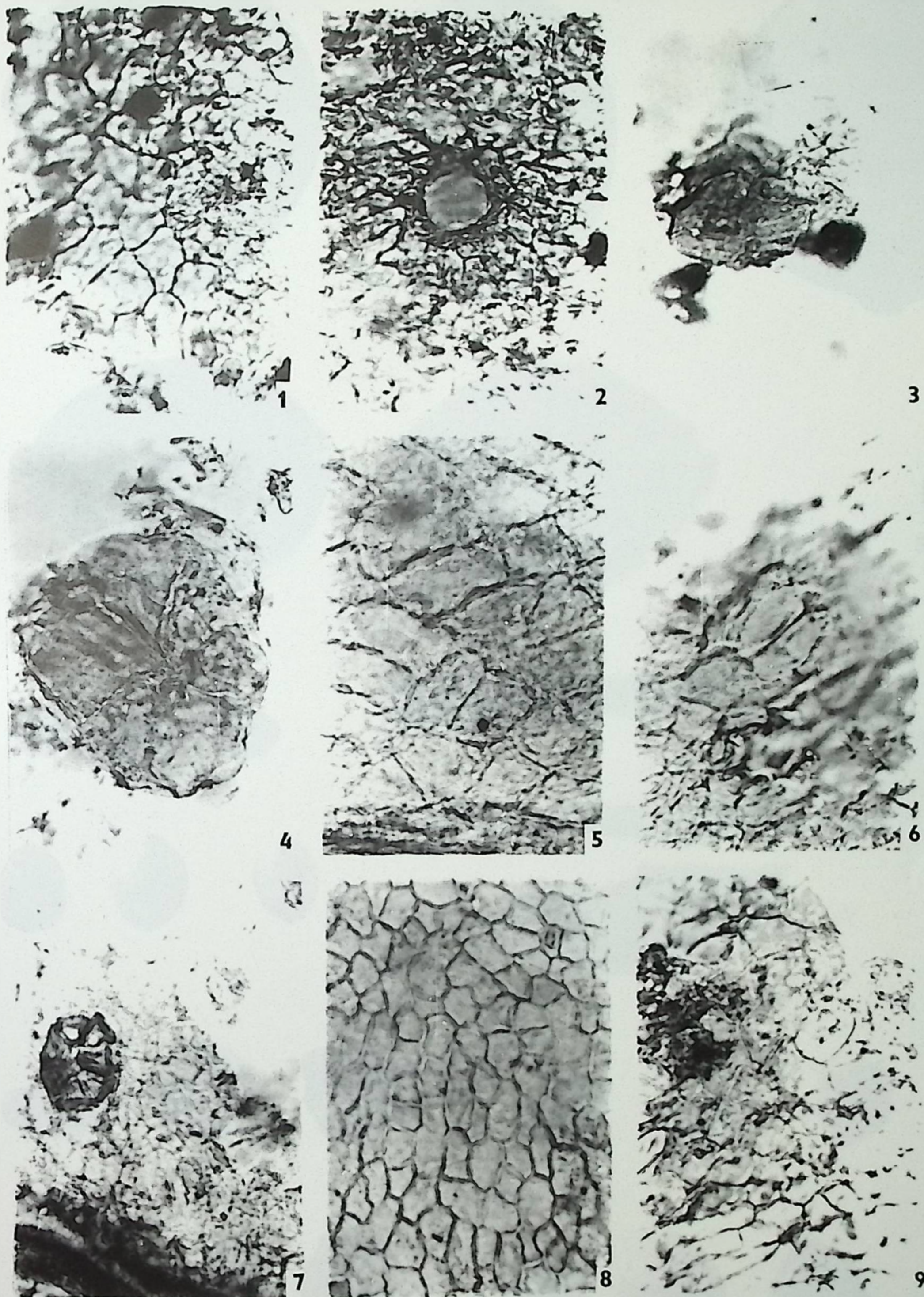


Plate 7



Tafel 8