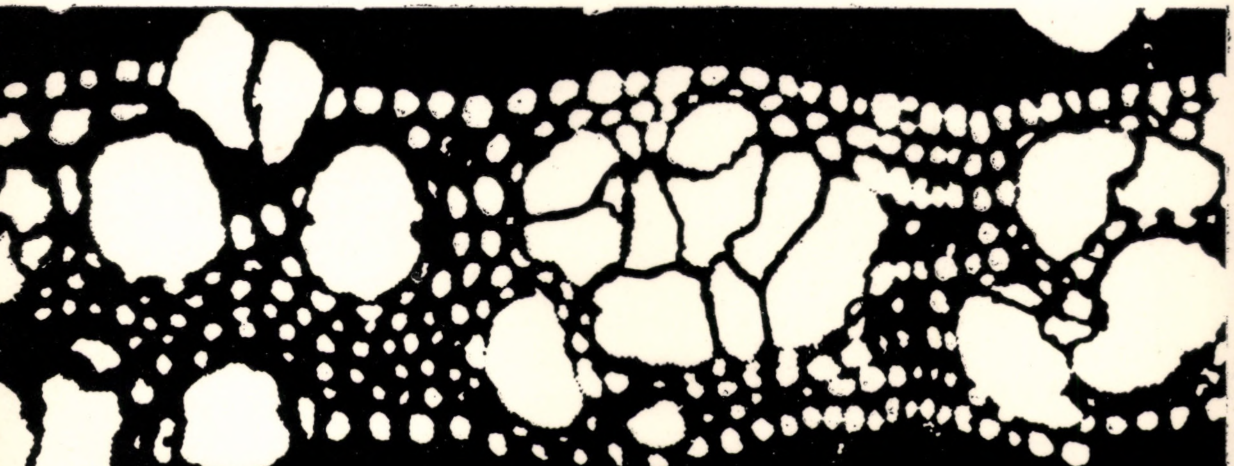
Pál Greguss

TERTIARY ANGIOSPERM WOODS IN HUNGARY



AKADÉMIAI KIADÓ, BUDAPEST

PÁL GREGUSS

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As a direct continuation of author's Fossil Gymnosperm Woods in Hungary from the Permian to the Pliocene (1967), this volume presents the xylotomical elaboration of the remains of palms and dicotyledonous trees that were once living in the Tertiary age of present-day Hungary. Recent investigation has stated that during the period extending from the Tertiary to the Pliocene, Hungary, as well as Middle Europe, was inhabited, in addition to gymnospermous woods, by families of palms and other thermophyl angiospermous trees which now have their nearest relations in tropical areas. Their geological and actual distribution is illustrated by means of 18 comparative maps inserted in the textual part of the book. Based on xylotomical examination of the fossil remains, the author also makes conclusions as to the likely changes of climate and temperature in Hungary and its Middle-European neighbourhood during the last 60 million years. His inferences are supported by way of illustration with 93 tables containing some 723 original photographs. Being of a pioneer character in more than one respect, the work will give useful information to theoreticians of scientific institutes, universtiy establishments and will be valuable for paleontologists, geologists, archeologists, miners and phylogenists.

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TERTIARY ANGIOSPERM WOODS IN HUNGARY

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by

PÁL GREGUSS

D. Sc. (Biol.), Professor, Szeged

723 original microphotos on 93 plates; 18 maps and 2 tables

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Translated by

S. Országh

Redigit

I. Pálfalvy

Supervised by

E. Vadász

Member of the Hungarian Academy of Sciences

and

G. Andreánszky, C. Sc.

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PREFACE

As regards contents, the present book is the direct continuation of my earlier work on the *Fossil Gymnosperm Woods in Hungary from the Permian to the Pliocene* published in 1967.

Also the composition of the book runs much on the same line as that of the previously mentioned publication. Thus the first part informs the reader about the fossil angiospermous trees, studied thus far, of Hungarian provenance. Then the localities of fossils treated by Hungarian authors, and the geological ages of the deposits are systematically reviewed. The Geological Description contains inferences based on the climate and phytogeography of the Cenozoic. Phytogeography is elucidated by several maps showing the fossiliferous localities, with a special emphasis on the Hungarian ones. Further maps show the relative abundance of finds in the Hungarian Cenozoic, as well as the changes undergone by the vegetal cover during that period in the present Hungarian territory. A comprehensive list of species and genera of fossil trees whose woods or pollens have been encountered in Hungary is also presented.

I have been assisted in the preparation of the present work by the same persons who participated in my book on the Gymnosperms, to whom I owe a debt of sincere gratitude.

Thanks are further due to the Section of Geo- and Mining Sciences of the Hungarian Academy of Sciences for having made possible the publication of many years' collected results.

Pál Greguss

EXAMINATION UP TO NOW OF THE RELICTS IN HUNGARY

A sporadic collection of fossil tree relicts in Hungary has set on as early as in the second part of the past century. Their elaboration had been undertaken by foreign specialists Goeppert, Unger, Félix, Heer, continued at the beginning of the present century by Lingelsheim, Kräusel, Hofmann and more recently by Müller-Stoll.

The investigation of charcoal relicts has set on in Hungary with the activities of Hollendonner and continued with the examinations of Greguss, Sárkány, Stieber. These sporadic examinations, however, consisted mainly of the so-called antracotomical elaboration of the Quaternary charcoal relicts which are not considered palaeoxylotomic examinations in the proper sense of the word and are therefore not dealt with here.

The first examinations of fossil stems originating from the present area of Hungary were initiated by the palaeontologist Félix (1884) in Leipzig who discusses in his study the tissue structure of several fossil trees originating from Hungary and describes some of them as new species. As to the age of the fossils, in the last lines of his study this author states that "in Hungary an abundant and diversified flora existed in the Pliocene". Among the relicts originating from the area of this country he describes the species *Quercinium böckhianum* collected at Megyaszó. This fossil was requalified by Müller-Stoll and Mädel (1960) to *Quercoxylon böckhianum.*

Liquidambaroxylon speciosum and *Betulinum priscum* also came to light near Megyaszó and were also determined by Félix.

In 1887 appeared a study of Félix in which several silicified stems originating from Hungary were determined. Unfortunately for most of the stems examined there are no reliable data in this study concerning the place of origin, only for the specimen of *Plataninium regulare* Félix; it is mentioned that it was found by Gy. Halaváts near Budafok in a layer pertaining to the Helvetian stage. On the basis of the description and drawings it cannot be concluded with full certainty on a plane-tree, because no detailed data are published either on the structure of the medullary rays or on the pitting of the vessels. In our opinion it can be *Platanus* but it may belong also to another similar genus. We refer to it, however, as a historical data under the name of *Platanoxylon.*

Tuzson was the first Hungarian research worker to deal at the beginning of the century with the xylotomy of fossil trees in Hungary and their determination.

Tuzson (1906) in his work determined a fossil collected from about 12 places as *Magnolites silvatica.* These are, however, probably neither *Magnolia* nor *Plata-*

nus but rather some *Icacinoxylon* relicts, at least such conclusion can be drawn on the basis of descriptions and drawings. The fossils examined came to light from the Tertiary gravel layers in the surroundings of Rátót-Őskű, Kádárta, Márkó, Herend, Dudar, Szápár-Csetény, Felsőgalla and Vértessomló.

The fossil determined under the name of *Celtites kleinii* originates from Tertiary gravel layers of Sümeg. On the grounds of the descriptions and the colour drawing published the determination is likely but not sure because the separation of *Celtis*, *Ulmus* and *Zelkova* is carried out on the strength of the structure of the medullary ray system which Tuzson does not refer to.

In his work mentioned above, Tuzson described two more fossils. One of these originates from the mediterranean gravel layer of Városlőd in Veszprém County while the other from Pét. Tuzson on account of the insufficiency of anatomical features dispensed with determination of the fossils referred to. He merely states in his study that in both fossils the limits of the annual rings are indistinct, the medullary rays are uni- to triseriate, the vessels solitary or forming shorter or longer pore rays. In our opinion both fossils may be *Pterocarya* since in both of them the medullary rays are two- or triseriate, in the annual rings the vessels are solitary, the twin pores following each other in short pore rays of 3 or 5 members. This assumption is supported also by the radial structure of the fossil. Consequently, the fossil wood is by no means *Magnolia* or *Platanus*.

In the wake of Tuzson followed Hollendonner who performed a pioneer work first of all in the xylotomical elaboration of prehistoric charcoals.

Although Tuzson and Hollendonner began the examination of fossil trees with remarkable results, still part of the fossil tree relicts collected in the territory of Hungary were sent abroad for examination. So, e.g., L. Lóczy sen. has sent part of the silicified trees of Hungary to Lingelsheim.

Lingelsheim (1917) determined in his study the palm stems collected in Hungary. From his enumeration of the fossil trees in Hungary only the palm species *Palmoxylon magyaricum* collected at Nógrádszakál is maintained.

During and following World War I palaeoxylotomic research work was suspended for a time. Elise Hofmann (1928) in her study determined a silicified stem as *Quercoxylon cerris*, another as *Fraxinoxylon excelsior* and a third as *Tilioxylon* sp.

Hofmann (1939) determined fossils collected at Fürzérkomlós and Füzérkajata under the names of *Ericoxylon arborea*, *Ulmoxylon campestre*, *Ilicoxylon* cf. *aquifolium* and *Aceroxylon campestre*.

Subsequently, for almost 10 years no palaeoxylotomical studies of consequence appeared which can be attributed partly to the tension preceding World War II.

Greguss (1943a) re-examined the fossils of Elise Hofmann from Sarmatian deposits of the Tokaj mountains and determined *Ericoxylon arborea* as *Fraxinoxylon komlosense*, *Ulmoxylon campestre* as *Celtixylon campestre*, *Aceroxylon campestre* as *Aceroxylon* cf. *palaeosaccharinum* and *Ilicoxylon aquifolium* as *Ilicoxylon* cf. *aquifolium*. In another study Greguss (1943b) determined two fossils, the one as *Carpinoxylon hungaricum*, the other as *Eucaryoxylon crystallophorum*.

From the beginning of the fifties palaeobotanical and palaeoxylotomical research in Hungary becomes livelier and more workers turn towards investigations of this kind.

Andreánszky (1951b) determined from the environments of Mikófalva several silicified stems, thus the species *Pinuxylon bükkense*, *Taxodioxylon sequoiadendri*, *Platanoxylon* sp., *Populoxylon* sp. (cf. *Populus tremula*), *Fraxinoxylon* sp. (cf. *Fraxinus americana*), *Quercoxylon avasense*. Andreánszky (1959) in his work discusses from Mikófalva beside those mentioned above also *Magnolioxylon*, *Liquidambaroxylon*, *Quercoxylon*, *Pterocarioxylon* and *Fraxinoxylon*.

Andreánszky (1953) in his work describes relicts of *Pinuxylon karancsense* Andreánszky, *Taxodioxylon taxodii* Gothan, *Cupressinoxylon* sp., *Pterocarioxylon* sp., *Quercoxylon* sp., *Juglandoxylon* sp. and *Ulmoxylon* sp. with photographs of all species except *Pterocarioxylon*. The age of the stems extends from the Upper Eocene to Pannonian. He stresses in his study that the determinations of age are not always reliable. In his opinion the woody plant relicts of the tropical Miocene are for the most part probably shrubs, thus the *Cinnamomum*, *Ficus tiliaefolia* and part of *Leguminosae*.

Greguss (1954) determines also some characteristic fossilized trees of the silicified Lower Miocene forest of Ipolytarnóc, among others a *Sequoioxylon*, *Pinuxylon albicauloides*, *Pinuxylon primum*, *P. secundum* and *P. tertium* as well as a probable *Keteleeria* relict, a *Palmoxylon sabaloides*, *Laurinoxylon aniboides*, *Laurinoxylon müller-stollii* and a *Magnolites silvaticum* Tuzson. This latter one he recently re-examined and described under the name of *Icacinoxylon silvaticum*.

Horváth (1954) elaborated the silicified stems of Csordáskút at Megyaszó and determined them as the species *Liquidambaroxylon speciosum*, *Betuloxylon* cf. *Betula alba*, *Maloxylon* or *Pomoxylon* cf. *Malus silvestris*, *Ulmoxylon* cf. *Ulmus americana*, *Celtixylon* cf. *Celtis occidentalis*, *Zelkovoxylon* cf. *Zelkova serrata* and *Populoxylon* cf. *Populus alba*.

Andreánszky (1955) in a special chapter of a collective work discusses the silicified stems of the Tertiary. In his study he determines the lignite of Várpalota as *Taxodioxylon sequoianum* (Merklin) Gothan, the Sarmatian fossil from the andesite mine near Selyp as *Pterocarioxylon*, that of Sóshartyán *Aceroxylon*, another from Sajókazinc as *Taxodioxylon taxodii*, from Egerszalók as *Fagoxylon* or *Fraxinoxylon* sp. respectively (cf. *Fraxinus excelsior*), from Mikófalva as *Liquidambaroxylon speciosum* Félix and another one as *Pterocaryoxylon*.

In the same symposium appeared the study of Stieber in which he determined a fossil collected at Király as *Taxus* while another as *Zelkova* or *Celtis*.

According to the determination of Éva Kovács (1955) the oak stem collected on the Kissvábhegy in Budapest is similar to the Austrian oak type, that of Romhánypuszta is more characteristic of the *Quercus robur* type, the stem of Kemenesmagasi is suggestive of the structure of *Quercus pubescens*, that found near Buják reminds of *Quercus ilex*, that of Miskolc-Tapolca was found similar to the species *Quercus frainetto* while the stem of Megyaszó is again suggestive of the species *Quercus cerris*.

Haraszty (1958) subsequently reports on the examination of several silicified pieces of stems from the environment of Herend-Szentgál and determines them as *Taxodioxylon taxodii*, *Taxodioxylon gypsaceum*, *Cupressinoxylon*, *Palmoxylon* and *Betuloxylon*.

Greguss (1959b) worked out the xylotomy of 303 trees and shrubs living in Europe. This work is an efficient aid particularly in the determination of wood relicts that came to light from the Tertiary and Quaternary strata.

Greguss (1959a) demonstrated from the Helvetian coal layers of Salgótarján the species *Palmoxylon hungaricum*.

Széky-Fuchs (1959) discusses a stem determined as *Fraxinoxylon* from Kányahegy at Telkibánya which Andreánszky determined as *Fraxinoxylon*.

Müller-Stoll and Mädel re-examined those fossilized oak relicts from the present territory of Hungary which were discussed at a time by Unger and Félix. On the strength of their results they gave them the new names *Quercoxylon densum*, *Quercoxylon böckhianum* and *Quercoxylon viticulosum*.

In 1962, Müller-Stoll and Mädel described from the Salgótarján basin a new *Myrica* species. Greguss (1963) described a new *Tetracentronites hungaricum* species from the Tokaj basin; in 1967 a *Sequoia* from Hidas, and *Diospyroxylon*, *Liquidambaroxylon*, *Ulmoxylon* from Ipolytarnóc, Sámsonháza and Mátraverebély (Helvetian).

In the foregoing we enumerated the studies and works which have briefly or more in length dealt, up to the present, with the determinations of fossilized trees in Hungary. From the enumeration it appears that the palaeoxylotomical research work which started in this country as early as in the second half of the past century has continued more intensively only 2 or 3 decades ago and is going on with assiduity.

SYSTEMATIC CLASSIFICATION*

MONOCOTYLEDONES

1. PALMAE				
Palmoxylon dorogense n. sp.	Dorog	Oligocene	I	19
Palmoxylon lacunosum var. *axoniense* Watelet	Diósjenő	Helvetian	VI	21
Palmoxylon sp. (det. by Haraszty)	Szentgál	Tortonian		
Palmoxylon hungaricum Greguss	Salgótarján	Helvetian	IV and V	21
Palmoxylon sabaloides Greguss	Ipolytarnóc	Burdigalian	II and III	20
Palmoxylon magyaricum (det. by Lingelsheim)	Nógrádszakál	Sarmatian		
Palmoxylon sp. (det. by Haraszty)	Rudabánya	Pannonian		
Palmoxylon sp. (mentioned by Andreánszky)	Szentgál	Tortonian		

DICOTYLEDONES

DIALIPETALAE

2. TETRACENTRACEAE				
Tetracentronites hungaricum Greguss	Tokaj	Sarmatian	VII–IX	24
3. FLACOURTIACEAE				
Flacourtioxylon sp.? (*Nyssoxylon?*)	Tatabánya	Middle Eocene	X	24
4. DILLENIACEAE				
Dillenioxylon mikófalvense n.gen. et n. sp.	Mikófalva	Sarmatian	XI	26
5. LAURACEAE				
? *Cinnamomoxylon* sp. (No. 1)	Dorog	Oligocene	XX	37
? *Cinnamomoxylon* sp. (No. 2)	Mogyoród	Helvetian	XVIII	37
? *Cinnamomoxylon* sp. (No. 3)	Cserháthaláp	Helvetian	XXI	38
? *Cinnamomoxylon* sp. (No. 4)	Budaörs	Helvetian	XXI	39

* The list contains references to the name, locality and geological age of the fossil stems, as well as to the numbers of the Plates in Roman numerals. Arabic numbers refer to pages in the Systematic Description. No number of Plate is given if the fossil stem was collected and identified by other authors, and the photos or drawings have already been published.

Laurinoxylon süssi n. sp.	Szokolya	Helvetian	XVIII	35
Laurinoxylon vadászi Greguss	Hidas	Helvetian	XII	28
Laurinoxylon aniboides Greguss em. Süss	Ipolytarnóc	Burdigalian	XIV	30
Laurinoxylon cf. *californicum* (Platen) Süss	Zagyvapálfalva	Lower Helvetian	XV	31
Laurinoxylon daberi n. sp.	Jobbágyi	Tortonian	XVII	34
Laurinoxylon cf. *hasenbergense* Süss	Salgótarján	Helvetian	XIII	29
Laurinoxylon müller-stollii Greguss em. Süss	Ipolytarnóc	Burdigalian	XIV	31
? *Laurinoxylon* sp.	Apátvarasd	Helvetian	XIX	36
Laurinoxylon pálfalvyi n. sp.	Becske	Burdigalian	XVI	32
6. Myristicaceae				
Myristicoxylon hungaricum n. sp.	Budakalász	Lower Oligocene	XXII	40
Myristicoxylon bajnaense n. sp.	Bajna	Oligocene	XXIII	41
7. Hamamelidaceae				
Liquidambaroxylon weylandi n. sp.	Szécsény	Helvetian	XXIV	42
Liquidambaroxylon horváthi n. sp.	Kárász	Helvetian	XXV	43
Liquidambaroxylon kräuseli n. sp.	Nógrádszakál	Sarmatian	XXVI	44
Liquidambaroxylon mägdefraui n. sp.	Szarvaskő	Helvetian	XXVII	45
Liquidambar sp. (det. by Horváth)	Megyaszó	Pannonian		
Liquidambaroxylon cf. *speciosum* Félix	Nagyvisnyó	Helvetian	XXVIII	46
Liquidambaroxylon speciosum Félix	Megyaszó	Pannonian		
Liquidambaroxylon speciosum Félix (det. by Andreánszky)	Mikófalva	Lower Sarmatian		
Liquidambaroxylon cf. *styraciflua*	Sámsonháza	Helvetian	LXVII	48
8. Platanaceae				
Platanoxylon sp. (det. by Andreánszky)	Mikófalva	Sarmatian		49
Plataninium regulare (det. by Félix)	Budafok	Helvetian		
9. Rosaceae				
Malus (det. by Horváth)	Megyaszó	Pannonian		
10. Leguminosae				
Albizzioxylon hungaricum n. sp.	Szurdokpüspöki	Tortonian	XXIX and XXX	50
11. Dipterocarpaceae				
Shoreoxylon pénzesi n. sp.	Budafok	Helvetian	XXXI	51
Shoreoxylon cf. *holdeni* Ramanujam	Tatabánya	Eocene	XXXIII	53
Shoreoxylon sp.	Rudabánya	Pannonian	XXXII	52
12. Tiliaceae				
Tilia sp. (det. by Hofmann)	Szombathely	Pannonian		

13. STERCULIACEAE				
Sterculioxylon sp.?	Dorog	Oligocene	XXXIV	55
14. ACERACEAE				
Aceroxylon sp. (det. by Andreánszky)	Sóshartyán	Sarmatian		
Aceroxylon cf. *palaeosaccharinum* Greguss	Füzérkomlós	Sarmatian	XXXV	56
15. AQUIFOLIACEAE				
Ilicoxylon cf. *aquifolium* Hofmann em. Greguss	Füzérkomlós	Sarmatian	XXXVII	58
Ilicoxylon theresiae n. sp.	Vékény	Helvetian	XXXVI	56
16. VITACEAE				
Vitioxylon megyaszóense n. sp.	Megyaszó	Lower Pannonian	XXXVIII	58
17. ICACINACEAE				
Citronella cf. *mucronata* D. Don.	Ipolytarnóc	Burdigalian	XXXIX	60
Icacinoxylon hortobágyii n. sp.	Balaton	Helvetian	XLIII	62
Icacinoxylon cf. *citronelloides* Shilk.	Ajka	Helvetian	XLI	61
Icacinoxylon cf. *goderdzicum* Shilk.	Szilvásvárad	Sarmatian	XLII	62
Icacinoxylon citronelloides Shilk.	Tokod-Altáró	Oligocene	XL	61
Icacinoxylon laticiphorum n. sp.	Dorog	Oligocene	XLIV and XLV	63
Icacinoxylon crystallophorum n. sp.	Dorog	Oligocene	XLVI and XLVII	64
Icacinoxylon platanoides n. sp.	Zirc	Helvetian	XLIX	66
Icacinoxylon shilkinae n. sp.	Pomáz	Helvetian	XLVIII	65
Icacinoxylon sylvaticum (Tuzson) Greguss n. comb.	Ipolytarnóc	Burdigalian	L and LI	67
Icacinoxylon sp.? (No. 1) seu *Platanoxylon* sp.	Dorog	Oligocene	LII	67
Icacinoxylon sp.? (No. 2) seu *Platanoxylon* sp.	Bajna	Oligocene	LIII	68
Icacinoxylon sp.? (No. 3) seu *Platanoxylon* sp.	Cserháthaláp	Helvetian	LIV	68
Icacinoxylon sp.? (No. 4) seu *Platanoxylon* sp.	Várpalota	Lower Helvetian	LV	68
Icacinoxylon sp.? (No. 5) seu *Platanoxy on* sp.	Cinkota	Helvetian	LVI	68
Icacinoxylon sp.? (No. 6) seu *Platanoxylon* sp.	Pécsszabolcs	Helvetian	LVII	69
Icacinoxylon sp.? (No. 7) seu *Platanoxylon* sp.	Mór	Helvetian	LVIII	69
Icacinoxylon sp.? (No. 8) seu *Platanoxylon* sp.	Megyaszó	Sarmatian	LVIII	70
Icacinoxylon sp.? (No. 9) seu *Platanoxylon* sp.	Budapest	Helvetian	LIX	70
Icacinoxylon sp.? (No. 10) seu *Platanoxylon* sp.	Hárságy	Helvetian	LIX	70

Icacinoxylon sp.? (No. 11) seu *Platanoxylon* sp.	Bodajk	Lower Helvetian	LX	70
Icacinoxylon sp.? (No. 12) seu *Platanoxylon* sp.	Iszkaszent-györgy	Helvetian	LX	70
Icacinoxylon sp.? (No. 13) seu *Platanoxylon* sp.	Homokbödöge	Helvetian	LX	70
Icacinoxylon sp.? (No. 14) seu *Platanoxylon* sp.	Solymár	Oligocene	LIX	70
Icacinoxylon sp.? (No. 15) seu *Platanoxylon* sp.	Pénzeskút	Helvetian	LIX	70
Icacinoxylon sp.? (No. 16) seu *Platanoxylon* sp.	Rátka	Sarmatian	LIX	70
Icacinoxylon sp. (No. 17) seu *Platanoxylon* sp.	Nagybátony	Burdigalian	LVI and LXI	71
Icacinoxylon sp. (No. 18) seu *Platanoxylon* sp.	Nógrád	Helvetian	LXII	71
MONOCHLAMYDEAE				
18. BETULACEAE				
Alnus sp.	Emőd	Pleistocene	LXIII	71
Betula sp. (det. by Horváth)	Megyaszó	Lower Pannonian		
Betuloxylon sp. (det. by Haraszty)	Szentgál	Tortonian		
Betulinium (*Betuloxylon*) *priscum* Félix	Megyaszó	Lower Pannonian		
Carpinoxylon sp.	Ipolytarnóc	Burdigalian	LXV	72
Carpinoxylon hungaricum Greguss	Füzérkomlós	Sarmatian	LXIV	72
19. FAGACEAE				
Fagoxylon (?) (det. by Andreánszky)	Egerszalók	Sarmatian		
Quercoxylon cf. *böckhianum* Müller-Stoll and Mädel (No. 1)	Kemenesmagasi	Pannonian	LXVIII	75
Quercoxylon cf. *böckhianum* Müller-Stoll and Mädel (No. 2)	Tata	Oligocene	LXVIII	75
Quercoxylon cf. *böckhianum* Müller-Stoll and Mädel (No. 3)	Dorog	Oligocene	LXVIII	75
Quercoxylon sp. (No. 1)	Monosbél	Helvetian	LXVII	73
Quercus sp. (No. 2)	Cegléd	Pleistocene	LXVII	74
Quercoxylon sp. (No. 3)	Pestszentlőrinc	Pannonian	LXVI	74
Quercoxylon avasense Andreánszky	Miskolc	Sarmatian		
Quercoxylon viticulosum (Ung.) (det. by Müller-Stoll and Mädel)	Megyaszó–Nagyvölgy	Pannonian		
Quercoxylon suberoides n. sp.	Sály	Sarmatian	LXVI	73
Quercus cf. *cerris* (det. by Hofmann)	Szombathely	Pannonian		

Quercoxylon sp. (det. by Éva Kovács)	Rombánypuszta	Burdigalian		
Quercoxylon sp. *Quercoxylon ilex* L. (det. by Éva Kovács)	Buják	Sarmatian		
Quercoxylon sp. (det. by Éva Kovács)	Miskolc-Tapolca	Sarmatian		
20. Juglandaceae				
Eucaryoxylon budense n. sp.	Budapest	Lower Helvetian	LXXII	79
Eucaryoxylon crystallophorum Müller-Stoll and Mädel	Füzérkomlós	Sarmatian	LXXIII	81
Pterocaryoxylon pannonicum Müller-Stoll and Mädel	Parádfürdő	Lower Helvetian	LXIX	76
Pterocaryoxylon cf. *pannonicum* Müller-Stoll and Mädel	Nemti	Lower Helvetian	LXX	77
Pterocaryoxylon pilinyense n. sp.	Piliny	Helvetian	LXXI	77
Pterocarya sp. (det. by Tuzson)	Városlőd	Helvetian		
Pterocaryoxylon sp. (det. by Andreánszky)	Selyp	Pannonian		
Pterocaryoxylon sp. (det. by Andreánszky)	Mikófalva	Sarmatian		81
21. Salicaceae				
Populoxylon sp. (cf. *Populus tremula* L.)	Mikófalva	Sarmatian	LXXV	83
Populoxylon sp. (cf. *Populus alba* L.)	Mikófalva	Sarmatian	LXXIV	82
Populoxylon sp. (det. by Andreánszky)	Mikófalva	Sarmatian		
Populus (det. by Horváth)	Megyaszó	Pannonian		
22. Ulmaceae				
Celtixylon campestre (Hofmann) n. comb.	Füzérkomlós	Sarmatian	LXXIX	88
Celtites (*Celtixylon*) *kleinii* Tuzson	Sümeg	Helvetian		
Ulmoxylon sp. (cf. *Ulmus scabra* Mill.)	Szigliget	Helvetian	LXXV	86
Ulmoxylon sp. Greguss	Mátraverebély	Helvetian	XC	87
Ulmoxylon cf. *carpinifolia* Gled.	Pásztó	Sarmatian–Pannonian	LXXVIII	86
Ulmoxylon scabroides n. sp.	Sámsonháza	Helvetian	LXXVII	85
Ulmus? Celtis? Zelkova sp. (det. by Horváth)	Megyaszó	Pannonian		
Ulmus sp.	Újfalu	Pleistocene	LXV	88
Zelkovoxylon yatsenko-khmelevskyi n. sp.	Nógrádszakál	Lower Sarmatian	LXXVI	83
Zelkova sp., *Celtis* sp. (det. by Stieber)	Királd	Burdigalian		
23. Meliaceae				
Meliaceoxylon matrense n. sp.	Mátranovák	Lower Helvetian	LXXX	89

24. EUPHORBIACEAE				
Euphorbioxylon secretiphorum n. sp.	Szarvaskő	Helvetian	LXXXI and LXXXII	90
Euphorbioxylon dorogense n. sp.	Dorog	Oligocene	LXXXIII–LXXXVI	91
Euphorbioxylon remyi n. sp.	Nógrádszakál	Sarmatian	LXXXVII and LXXXVIII	93
SYMPETALAE				
25. EBENACEAE				
Diospyroxylon cf. *ebenaster* Retz	Ipolytarnóc	Burdigalian	XC	95
Diospyroxylon sp.	Érd–Törökbálint	Helvetian	XC	95
Ebenoxylon hofmannae Greguss	Sirok	Oligocene	LXXXIX	98
Ebenoxylon knollii Hofmann	Sirok	Oligocene	LXXXIX	97
26. OLEACEAE				
Fraxinoxylon sp. (det. by Andreánszky)	Telkibánya	Sarmatian		
Fraxinoxylon sp. (det. by Andreánszky)	Mikófalva	Sarmatian		
Fraxinoxylon komlósense Greguss	Füzérkomlós	Sarmatian	XC, XCI and XCII	98
Fraxinoxylon sp. (det. by Andreánszky)	Egerszalók	Sarmatian		
Fraxinus sp. (det. by E. Hofmann)	Szombathely	Pannonian		
Fraxinoxylon cf. *Fraxinus excelsior* L.	Pestszentlőrinc	Pleistocene	XCI and XCIII	99

SYSTEMATIC DESCRIPTION*

MONOCOTYLEDONES

1. PALMAE

Palmoxylon dorogense n. sp.

Plate I, Figs 1–9.

Diagnosis: In texto fundamentali fasces trachearum dense dispositi, fasciculum fibrarum sclerenchymae et pars fascis tracheas continens circiter aequaliter latae. Fasces trachearum in genere 2 magnis, praeterea pluribus minoribus tracheis. Tracheae longitudinales scalariter et annulariter incrassatae. In perforatione 5–8 gradus scalares tenues, distantes. Stegmata structura radiali, polygonalia.

Descr. Generally two large vessels with scalariform thickenings are found near each other, in the xylem of the vascular bundle, and between them similar vessels with narrower lumina, as seen in Photo 4. Smaller sclerenchyma fascicles are embedded between the vascular bundles in the ground tissue (Fig. 6). The parenchyma cells of the ground tissue are more or less isodiametric (Fig. 6). The vessels also contain typical scalariform perforations, the number of the scales varies from 5 to 8 (Fig. 7); these are occasionally branching. They are comparatively thin and follow one another at great intervals. In the thinner vessels the thickening of the cell wall is either scalariform, when the scales reach quite over the wall of the vessel, or the scales are interrupted and reticularly branching (Fig. 8). The structure of the scales in the broader vessels is represented in Fig. 9.

Note: One piece of stem among the fossils of Dorog must be a palm (Figs 1, 2 and 3). Rákosi, however, was not able to determine the genus since he could establish no finer morphological features.

The Indian worker Kaul (1960) refers also to the structure of the vascular bundles of various types of palms (Plate I). Considering his information, our fossil bears closest resemblance to the type *Sabal palmetto* since the sclerenchyma fascicles do not completely surround the vascular bundles but are separated from them in horizontal plane. The similarity is also shown by the width of the scleren-

* Abbreviations used throughout this book are as follows: **C.** = cross section; **R.** = radial section; **T.** = tangential section; **L.** = locality; **A.** = geological age.

chyma fascicle being about the same as that of the vascular bundles together with the width of their surroundings (Fig. 2).

We should also mention the stegmata which cover the surface of the sclerenchyma fibres in long rows. Their shape is characteristic. The surface picture of such stegmata is shown in Fig. 5. Also the Palmoxylon species of Lingelsheim (1917) may be related to the fossil, because it has also stegmata, though their forms and structures are different. Since the fossil of Dorog is definitely distinct from *Palmoxylon hungaricum*, from *P. magyaricum* of Nógrádszakál, *P. lóczyanum* of Verespatak and from the palm of Ipolytarnóc, we propose to distinguish it by the name *Palmoxylon dorogense*.

L. Dorog; **A.** Oligocene.

Palmoxylon sabaloides Greguss

Plates II, Figs 1–6; III, Figs 7–11.

The 1 to 30 magnification of the cross slide (Fig. 1) suggests a monocotyledonous plant. On the picture of low magnification (1 to 10) it is easily discernible that the vascular bundles are arranged apparently scattered but still in rows running by and large parallel to the circumference. A portion of this is shown in Figs 2, 3 and 4. Figure 3 demonstrates the structure of such single vascular bundle together with the sclerenchyma fascicle adjoining the collateral vascular bundle. Also Figs 5, 6, 7 and 8 represent each a collateral closed vascular bundle in higher magnification. The single vessels at some places are grouped while others are scattered between the ground-tissue cells. Figures 5 and 6 show the xylem portion of such a vascular bundle in 1 to 150 magnification. Also the thin-walled phloem plates and the parenchyma cells of the ground tissue are well discernible. Figure 11 presents the longitudinal structure of such vascular bundle in 1 to 30 magnification, while Fig. 10 reveals the longitudinal structure of a xylem bundle in 1 to 100 magnification. The scalariform or annular thickening of the tracheids is clearly seen in the photo. Also the arrangement and finer structure of the parenchyma cells surrounding the xylem bundles are observable. At some places the perforation of the vessels is visible. No dicotyledonous or gymnospermous plant has such xylem structure. Thus the stem surely derives from some monocotyledonous plant. Comparative data prove this structure to be most similar to the stem of palms.

The microscopic picture of a vascular bundle of *Sabal palmetto* in the book of Eames and Mac-Daniels (1951) agrees with that of the piece in question (Plate III, Fig. 9). This statement seems to be corroborated by the fact that Rásky (1960) found also *Sabal* leaves among the imprints.

Jablonszky (1914) discusses the leaf and fruit of *Calamus noszkyi*. The structure of the stem described does not agree with any *Calamus*. Also Andreánszky (1955) described a palm species from North Hungary when discussing the tertiary flora but analyses it only on the ground of imprints, and not of fossil stems.

It should be noted that recent representatives of the genus *Sabal* are still extant from the north of Venezuela up to the southern parts of North America. Its most northern form, *S. adansoni*, penetrates the 36° of northern latitude.

L. Ipolytarnóc; **A.** Burdigalian.

Palmoxylon hungaricum Greguss

Plates IV, Figs 1–6; V, Figs 7–10.

(*Palmoxylon hungaricum* Greguss, 1959a)

Diagnosis: Textum fundamentale in sectione transversali fascibus fibrorum et fascibus fibrorum-trachearum inordinate disperseque dispositis. Fasces fibrorum diametro 700–800 μ, fibra 25–30 sclerenchymatica continentes. Fasces fibrorum-trachearum 1200–1300 μ diam., fibris sclerenchymaticis 150–200. Fasces fibrorum-trachearum transversaliter secti reniformes, infra sinum in xylem plerumque 2 tracheae majores, diametro 120–130 μ, diametro trachearum minorum 40–50 μ. Cellulae parenchymae texti fundamentalis elongatae, cylindricae, tenues, apicibus sese tangentes, vel ad axem fascis fibrorum perpendiculariter sese accommodantes. Fasces fibrorum stegmatis parvis cooperti. Tracheae parietibus crassae, spiraliter scalariterque structae, perforatione scalari, gradibus tenuibus 8–10. Fibra sclerenchymatica parietibus crassis, stratosis, lumine valde angusto.

Note: The anatomical structure manifests a palm origin, but it is more difficult to answer the question to which genus the fossil belongs. It does not agree with any of the several palm stems known from Hungary.

It differs from *Palmoxylon pietzschii* described by Schönfeld (1955a) mainly in the cross section structure of the sclerenchyma bundles. The same applies to *Palmoxylon arcotense* described by Ramanujam (1953a), to *Palmoxylon lacunosum* described by Unger and *Palmoxylon shonicoides* originating from the Oligocene and described by Hofmann (1943). Because of the absence of fructifications and leaf remains we propose to designate the fossil of Salgótarján, only to distinguish it from the others, as *Palmoxylon hungaricum.*

L. Salgótarján; **A.** Helvetian.

Palmoxylon lacunosum var. *axoniense* Watelet

Plate VI, Figs 1–9.

Descr. **C.** It could be established with the naked eye that the fossil originates from some palm. Microscopic examination revealed that the place of the sclerenchyma fascicles was occupied by cavities, thus the sclerenchyma part was completely disorganized. The cross section forms of the sclerenchyma bundles are reniform, and at the concave side are located the collateral vascular bundles. The vascular bundles and the sclerenchyma fascicles pertaining to them are scattered in the ground tissue irregularly at distances of 1–3–5 vascular bundles (Fig. 1). The parenchyma cells of the ground tissue are more or less isodiametric, but even so of rather variable form. They are not so markedly elongated as in *Palmoxylon hungaricum*, they are much shorter. Here and there some remains of the sclerenchyma cells and the thin-walled parenchyma cells of the vascular bundles are seen at the edges of the reniform cavity (Figs 2 and 3). Thick-walled sclerenchyma-like cells with narrow lumina (idioblasts) between the thin-walled parenchyma cells of the ground tissue rather often occur (Fig. 5).

T. and **R.** Owing to the high degree of disorganization, the shape of the vessels, their spiral or annular thickening could not be established (Figs 4–6).

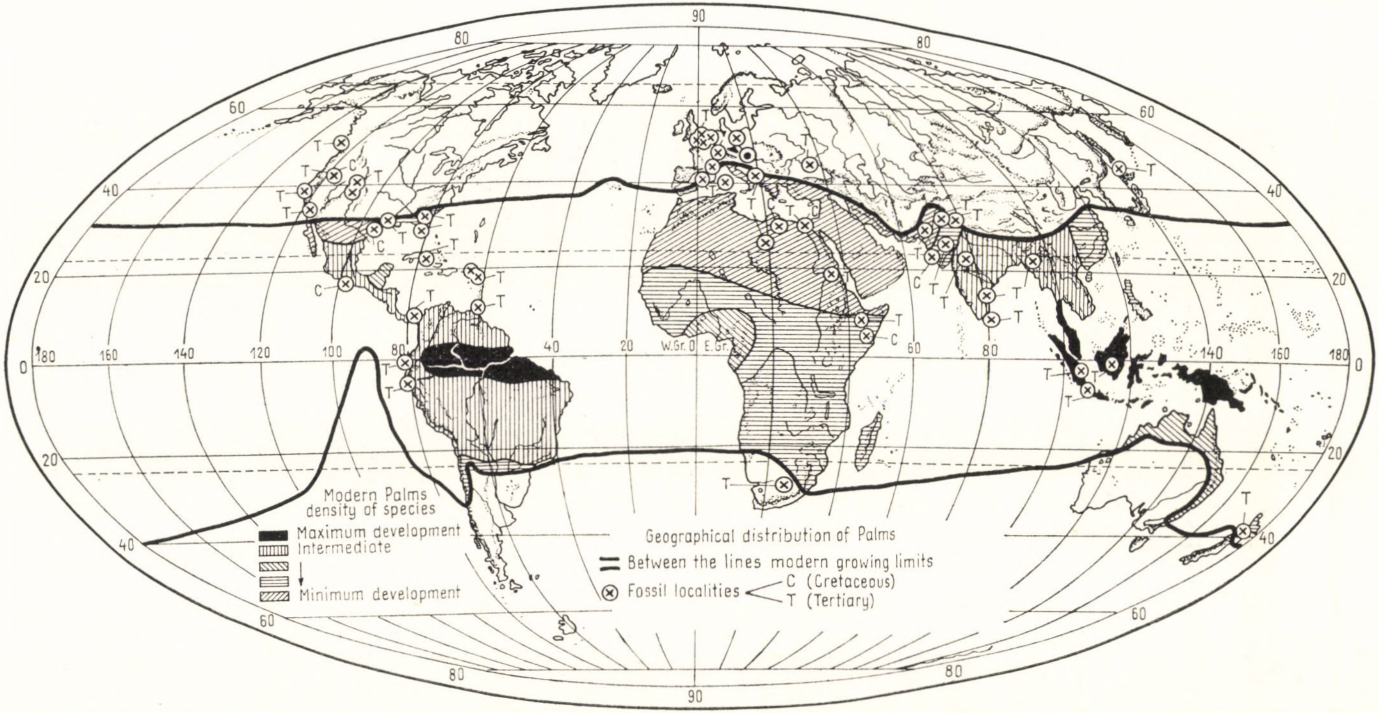
Note: The fossil described definitely differs as to the structure of the ground tissue from the palm species known from Hungary up to now. It is partly suggestive of *Palmoxylon lacunosum* described by Mägdefrau (1956) but still more of the variety *Palmoxylon lacunosum* var. *axoniense* Watelet. Therefore, with some reservation, we propose to class the stem of Diósjenő with this form group, the more so since there are 10–12 vascular bundles per sq. mm in the fossil, which corresponds to the group established by Stenzel as *Palmoxylon lacunosum* var. *axoniense*. The identification is the more plausible since both fossils originate from the Miocene.

L. Diósjenő, Dinnyéspuszta; **A.** Helvetian.

The original material is in the Hungarian National Museum under No. 61.570/2 while the preparations are in the palaeobotanical collection of the Hungarian Geological Institute.

In addition to the three sites referred to above, fossil palm stems have been exposed from several places of the present area of Hungary. Haraszty (1958) describes a *Palmoxylon* sp. from Herend–Szentgál. His photos of the cross and longitudinal slides are particularly convincing.

On the other hand, the data of Haraszty (1960) on *Palmoxylon* from Rudabánya seem to be dubious. The author himself was aware of the difficulty: "es war unmöglich, aus den zerfallenden bröckelnden Kohlenproben größere Schnittstücke zu machen." This appears in the photos published. The compressed cross slide (Figs 13 and 14) does not exhibit a palm structure at all. In the sclerenchyma fascicle flanking the vascular bundle there are no radially arranged cell rows as it clearly appears from Fig. 13. Such arrangement can be observed at most in the late wood of some conifers—e.g. *Sequoia*, *Taxodium*—where the thick-walled late tracheids run radially parallel to the annual ring boundaries. Anybody can see this by comparing Figs 1, 2, 5, 6, 8 and 9 in the study of Sárkány (1943) with the palm Photos 13 and 14 of Haraszty. Unfortunately, the author does not publish a picture of a longitudinal section or of a perforation, from which it could be decided whether or not the stem originates from a palm species.



Map 1. Recent distribution of Palms. Hungarian fossil sites (black spot). (After Kaul)

DICOTYLEDONES

DIALIPETALAE

2. TETRACENTRACEAE

Tetracentronites hungaricum Greguss

Plates VII, Figs 1 and 2; VIII, Figs 3–10; IX, Figs 11–20.

(Detailed description: Greguss, 1963)

3. FLACOURTIACEAE

Flacourtioxylon sp.? (*Nyssoxylon?*)

Plate X, Figs 1–9.

Descr. **C.** was of hardly any use, owing to its friable interior in which neither the arrangement nor the shape of the cells could be exactly established. Only the direction of the rays and the scattered arrangement of the pores, the paired pores or multiples of 3–4 vessels with narrow lumina could be guessed. Traces of the annual ring boundaries could be observed only occasionally. The ground tissue consisted beyond doubt of xylem fibre elements of narrow lumina fitting together in rows, or sometimes scattered. The rays are 1–4 cells wide, but their shape, owing to disorganization, cannot be established. The radial diameter of the ray cells is 24–40 μ, their width 12–14 μ, but larger and smaller ones also occur. Among the xylem fibres of the ground tissue, there appear cells with a dark content, probably parenchyma cells.

T. Between the longitudinal wood fibres 1–4 cell layer wide rays are seen (Figs 2 and 3). The cross sections of the ray cells are circles or regular hexagons-octogons (Fig. 3). Characteristically, the 2–4 cell layer wide rays are tapering to one cell layer at a height of 4–6 cells and continue almost as narrow tails (Figs 2 and 3). In the ray of one cell layer, the walls of the ray cells with a dark content are transverse or oblique (Fig. 3). The pitting can be merely guessed in the walls of the xylem fibres. The ray cells in the uniseriate continuation of the three or four layer wide rays are higher than those in the interior part, so the rays are heterogeneous (Fig. 3). The broad rays taper to uniseriate only on one side. Here the ray cells are 40–45 μ high, their width is 24–25 μ, while in the interior of the ray the height of the more or less circular ray cells is 15–17 μ. The height of one of the triseriate rays was 14 cells (Fig. 2), while that of the uniseriate portion in its continuation 7–8 cells. Along the uniseriate rays partly xylem fibres and partly wood parenchyma chains are arranged (Figs 2, 3, 5 and 7). The height of the wood parenchyma cells is 30–35 μ, their width 12–13 μ, there are 5–6–8 calcium oxalate crystals in some of them. Among the rays, the vessels with wider lumina run somewhat sinuously (Figs 4, 5, 6 and 7), their width is 80–90 μ. In their walls there are many bordered pits fitting tightly together in a mosaic pattern (Fig. 7). The vessels are full of tyloses (Figs 5 and 6). Translucent transverse spiral thickenings are formed in the walls of the vessels (Fig. 4). It is not quite clear, whether the spiral lines in the vessels originate from these spiral thickenings. Calcium oxalate crystals are rather frequent (arrows in Figs 3 and 4). From the tapering of the vessels some simple perforation may be inferred.

R. The heterogeneous structure of the rays could be definitely established (Fig. 9). The height of the ray cells is 17–20 μ, that of the marginal cells 35–40 μ.

The pitting of the ray cells cannot be examined, owing to the non-transparent dark content; vertical and narrow thickenings or pitting are seen only at one place in the cross field (arrow in Fig. 8). Shape and size of the parenchyma cells are the same as on the tangential side. On the surface of the wider vessels, the bordered pits fit together densely in a mosaic pattern. Similarly, the calcium oxalate crystals are arranged in 8–10 rows (arrow in Fig. 4).

Note: Owing to the high degree of disorganization, the vessels on the cross slide are scanty, no distinct annual ring boundaries are seen, and the ground tissue consists of xylem fibres of narrow lumina and abundant wood parenchyma. From such cross section, which occurs in many kinds of woods, we can only infer a mild, perhaps a warm tropical climate.

The tapering of the 1–4 cell layer wide rays into one cell layer portion reminds us of certain tropical woods, such as *Nyssaceae*, *Styracaceae*, *Euphorbiaceae*, *Phyllanthoideae*, *Myricaceae*, *Trochodendraceae*, *Flacourtiaceae*, *Theaceae*, *Dipterocarpaceae*, *Sterculiaceae*, *Elaeocarpaceae*, *Icacinaceae*, *Celastraceae*, *Staphyleaceae* and *Hamamelidaceae*.

Of course, it would be difficult to name the family of the fossil. According to the results of palaeophytology, palynology, the families *Nyssaceae*, *Flacourtiaceae*, *Maricaceae*, *Icacinaceae* and *Dipterocarpaceae* enter into consideration. Up to now, we succeeded in demonstrating a *Shoreoxylon* belonging to *Dipterocarpaceae*, which, however, definitely differs from the structure of the stem of Tata.

The ray structure of the recent species of the genus *Myrica* also differs from that of the fossil described, mainly in that its rays are generally one cell layer wide. In the absence of comparative material, primarily on the grounds of the similar structure of the rays, we classify this fossil conditionally to the family *Flacourtiaceae* with the remark that if we obtain material more suitable for examination from the same site, we shall modify or justify this determination.

L. Tatabánya (Márgabánya); **A.** Middle Eocene.

The material examined is in the Hungarian National Museum under No. 128 while the slides are in the palaeobotanical collection of the Hungarian Geological Institute.

4. DILLENIACEAE

Dillenioxylon mikófalvense n. gen. et n. sp.

Plate XI, Figs 1–10.

Diagnosis: Lignum disperse porosum, in stratis concentricis tracheae solitariae aequaliter distributae. Limites stratorum concentricorum manifesti, sed non insignes. Inter radios medullares latitudine ex 1 (–2) strato cellularum, altitudine ex 1–20 cellulis formatos parum remotius radii medullares latitudine ex 6–8 stratis cellularum, altitudine ex 60–120 cellulis formati. Laminae parenchymae apotrachealis latitudine ex uno strato cellularum formatae et plerumque radios medullares vicinos non connectentes. In radiis medullaribus latis (etiam sicut ex radiis medullaribus pluribus coacervatis explicabilibus) meatus horizontales mucum, vel materiam gummi similem continentes. Perforatio trachearum simpliciter scalaris, vel reticulata, in pariete trachearum pori foveolati oppositi, interdum praeter se 5–6 pori, aliis locis porus unicus elongate ellipticus, latitudinem tracheidae attingens. Pori oppositi nonnunquam gradatim in perforationem scalarem transeuntes.

Descr. **C.** The pores of the wood are diffuse and the annual ring boundaries can be only guessed. The vessels in the annual rings are single or paired, hardly concentrating into radial multiples. Their radial diameters are 70–80 μ, their widths about 50–60 μ. The lumina of the vessels are somewhat smaller in the late wood than in the early wood. At the end of the late wood, near the annual ring boundary, the number of the vessels diminishes and the xylem fibre comes to predominance. The apotracheal parenchyma arranged in short plates only very seldom connect two rays; they are one cell layer thick, and the plates are repeatedly interrupted. The cross sections of the vessels, probably because of the strong compression, became angular. The rays are generally 1 and 8–10 cell layers wide, i.e. of two different kinds. In the wider ones at some places mucous or rubber ducts are seen (Fig. 3). These broad rays are actually aggregate ones composed of a number of tiny short ray cells (Fig. 3).

T. The rays are 1–2 or 4–8 cell layers wide; the latter ones contain several rubber or mucous ducts (Fig. 5) separated or sometimes merged, and also xylem fibres and vessels with short members, in which tyloses occur. From the apotracheal parenchyma plates of the cross section we might infer *Engelhardtia* in which the distribution of the parenchyma is by and large identical with that in our fossil. The fossil differs from *Engelhardtia*, however, in that beside the narrow rays quite broad ones with many horizontal mucous or rubber ducts are present which, as far as we know, are missing in *Engelhardtia*. The uniseriate rays are of homogeneous structure, the cross sections of their cells are circles or hexagons.

R. The two types of ray structure can be established. The interior ray cells in the broad rays are procumbent rectangles, the marginal cells sometimes slightly higher than the interior ones, in their radial walls there are several tiny simple pits. Such pitting occurs particularly where the vessels and the ray cells meet. Their outside walls are somewhat undulating. The wider vessels are filled with tyloses. The vessels fit together with simple and scalariform perforation, the number of the scales being 20–30 (Fig. 8). There is a gradual transition of the scales into the pitting of the vessels (Fig. 7a). The bordered pits are arranged partly alternating (Fig. 9) partly opposed (Fig. 10), while the simple and great pits, which are short or highly elongated ellipses, follow each other opposed (Fig. 10). This primitive structure occurs in *Platan*s, *Liriodendron*s and other species closely related to these.

Note: The fossil examined is a diffuse porous wood, the annual ring borders are hardly perceptible while the vessels are single or paired; apotracheal parenchyma, broad and quite narrow or aggregate rays occur, simple and scalariform perforations are present simultaneously and in the vessels opposed simple bordered pitting is observed. These features taken all together do not occur in recent European trees, so the fossil examined represents some tropical or subtropical wood. It is most characteristic of the fossil that beside the broad rays also uni- and sometimes biseriate ones occur. The presence of apotracheal parenchyma and the scalariform or reticular perforation, as well as the opposed pitting in the vessels, are also remarkable. All these properties are such primitive features as greatly remind us of the *Magnoliaceae* and particularly of the *Dilleniaceae*. Of the several genera belonging to the latter the fossil is most suggestive of *Vormia*. In *Dilleniaceae* the vessels are single, and so are in our fossil. The perforation can be scalariform and simple, the pitting in the vessels opposed and almost scalariform, while the rays uni- and multiseriate. In the broad rays ducts course exactly as in the fossil. Unfortunately, no material of living tree could be procured for comparison. Metcalfe and Chalk's (1950) drawings marked I, J and L, presented in Plate XI, by and large agree with the anatomical features of the fossil examined. By its anatomical properties the silicified wood of Mikófalva can be brought in closer connection with the family *Dilleniaceae*, the more so since Pálfalvy (1963) found macrofossils from the Helvetian layers of the Mecsek mountains belonging to the *Dilleniaceae*. It is of importance that we succeeded in demonstrating another tree of primitive character, *Tetracentron*.

We propose to name the fossil with some reservation as *Dillenioxylon mikófalvense*.

L. Mikófalva; **A.** Sarmatian.

The material examined is in the Hungarian National Museum under No. 128 while the slides are in the palaeobotanical collection of the Hungarian Geological Institute.

5. LAURACEAE

Laurinoxylon vadászi Greguss

Plate XII, Figs 1–8.

T. The ray structure and the shape of the oil cells connected with them are suggestive of the Lower Miocene *Laurinoxylon müller-stollii* exposed at Ipolytarnóc, but it resembles *Laurinoxylon linderoides* and *Laurinoxylon parenchymatosum* described by Schönfeld (1956c), though Schönfeld did not establish oil cells in the latter. It is similar to *Laurinoxylon primigenium* and *L. aromaticum* described by Félix (1884), the rays of which are also 1–3 cells wide. Schönfeld (1933) refers to Knoblauch (1898): "Bezeichnend ist für die Laurineen, daß die Breite der Markstrahlen nie über 5 Zellen beträgt, gewöhnlich 1–3 oder 1–4 Zellen. Ein- bis fünfreihige Markstrahlen haben nur *Beilschmiedia*, *Persea gratissima*, *Actinodaphne*, *Laurus nobilis;* davon sind die Markstrahlen von *Laurus nobilis* gewöhnlich vierreihig, die von *Beilschmiedia* gewöhnlich fünfreihig." He further mentions that the rays of the genera pertaining to *Lauraceae* are at most 5 cell layers wide, so e.g. *Cinnamomum* is 1–3, *Persea ayui* at most 5 cells wide. As to this species he further states that its oil cells are very large and numerous. The rays are 1–3 cells wide in *Ocotea camerunensis*, 1–3, seldom 4 in *Nectandra rodioei*, 1–4 in *Sassafras*, 1–2 in *Tilostemon*, 1–3 in *Cryptocarya peumus*, 1–3 in *Lindera*, while exceptionally 5 cell layers wide rays may occur in the roots of *Laurus nobilis*. The same was stated by Metcalfe and Chalk (1950), Yatsenko-Khmelevsky (1954), Gammermann, Nikitin and Nikolaeva (1946) and Pax (1891).

Note: The presence of a great number of oil cells located partly in the ground tissue, partly along the rays as marginal cells, point to the family *Lauraceae*.

On the grounds of the morphological properties we propose to denominate this fossil as *Laurinoxylon vadászi* Greguss. Of the pertaining genera *Sassafras*, *Cinnamomum* and *Laurus* may enter into consideration. The fossil examined differs from all these mainly by the width of the rays. In the species described the rays have generally 3–4 cell layers, but some of them contain 6–8, and very exceptionally even 10. No such wide rays of *Lauraceae* are referred to in the literature. Thus the piece examined, in spite of its traits characteristic of *Lauraceae*, cannot be identified with the above genera or species.

It is possible that the stem examined is a kind of *Laurinoxylon* which may be brought into connection with the *Lauraceae* remains found in the Helvetian layers of the Mecsek mountains by Pálfalvy (1952, 1963).

The *Lauraceae* are extant at present both north and south of the Equator in tropical and subtropical areas, first of all in Southeast Asia, in the Sunda Islands and in Brasil, some species also in North America and in the Mediterranean area.

L. Hidas; **A.** Helvetian.

Laurinoxylon cf. *hasenbergense* Süss

Plate XIII, Figs 1–9.

Descr. **C.** Owing to creases and disorganization, intact histological structure apt for determination could be found only here and there. The annual ring boundary is blurred. In the annual rings the vessels are situated singly or grouped in multiples of twos; exceptionally also multiples of 3–4 elements occur. The cross sections of the solitary vessels are radially somewhat elongated ellipses, also the united cross section of two coalescent vessels is a more or less elongated ellipse, in the small axis of which the cell wall was seen between the two cells. The diameters of the single pores are 100–200 μ, those of the twin pores 200–220 μ. In some vessels a dark cell content fills the cell lumen totally, while in others only partially. Both the single and the paired pores are surrounded by vasicentric parenchyma. The rays are 2–4 cells wide and run radially at a distance of 8–10–15 tracheids. Also the tracheids of narrow lumina and the xylem fibres are aligned radially. Here and there tracheae with larger lumina are inserted in the rows of tracheids with narrow lumina. The parenchyma cells are either single and dispersed or located terminally. This paired structure of the pores is highly reminiscent of the species *Laurinoxylon müller-stollii* of Ipolytarnóc, which gives a decisive viewpoint for the determination (Figs 1, 2, 3).

T. The rays are generally 2–3 cell layers wide and 10–13 cells high. On the top and at the base of most of the spindle-shaped rays, the marginal cells seem to be empty, these are the oil-holding cells characteristic of *Lauraceae*. The height of these cells is 70–72 μ, their width 30–35 μ, that is they are in general twice as high as wide. The width of a 4 cell wide ray is 70 μ, the width of one cell about 20 μ, but they may be broader or narrower as well. The interior ray cells are closely annexed, their cross sections are hexagonal, arranged in a honeycomb pattern. The rays are closely surrounded by parenchyma cells or tracheids. The single members of the vessels are corresponding with oblique walls, their surface is covered by very dense and tiny bordered pits. The longitudinal extent of the parenchyma cells is 70–100 μ, their width 30–40 μ. Both in the ray parenchyma cells and in the longitudinal parenchyma cells, there is a granular content, probably of starch grains. In most oil-containing cells and in numerous parenchyma cells diamond-shaped, pentagonal or hexagonal crystals are frequent.

R. The Lauraceous character is still more conspicuous. The walls of the vessels with wide lumina are covered by very dense tiny bordered pits. The single vessel members at the places of contact are slightly constricted and communicate with each other by simple perforations. No scalariform perforation could be observed. The heterogeneous structure of the rays is conspicuous. The inner ray cells are horizontally elongated, their longitudinal extent is 150–200 μ, while their height ranges from 25 μ to 40 μ. The longitudinal sections of the oil cells arranged at the margin of the rays are squares, rounded or upright oblongs, but never conical. This is an important distinguishing feature. In the oil cells frequently rectangular or polygonal crystals are found, originating probably from the contents of the oil cells. The diameters of the longitudinal parenchyma cells are 70 to 100 μ, they are located in columns above each other; also in these angular crystals are frequent.

Note: Judged by the above morphological features, the fossil described belongs beyond doubt to the *Lauraceae* family. This is evidenced by the arrangement of the tracheae in the ground tissue, the vasicentric parenchyma and the presence of the oil cells.

The specific determination raises a difficult problem. The shape of the oil cells and the thinness of their walls distinguish it from the species in which the medial section of the oil cells is more conical and also their wall is rather thick. Süss (1960) mentions about 30 *Laurinoxylon* species. There is a great similarity between the photos of the *Laurinoxylon hasenbergense* published and those of the fossil of Salgótarján. Thus it is not impossible at all that the two fossils are identical, and we cannot go far wrong when regarding the piece of Salgótarján as *Laurinoxylon hasenbergense*, which is supported not only by the very same dimensions but also by the similar anatomical features.

L. Salgótarján; **A.** Helvetian.

Laurinoxylon aniboides Greguss em. Süss

Plate XIV, Figs 1–3.

C. alone, however, is not enough to establish a closer connection between the two kinds of wood. But if the radial structure of both are compared in identical magnification, the similarity is more convincing. Figure 3 of Plate XIV shows the radial structure of the fossil in 1 to 100 magnification.

The dimensions and arrangement of the longitudinally elongated oil-containing idioblasts, their location as well as height and arrangement of the ray cells are characteristic of *Lauraceae*. These oil cells are also clearly visible on the transverse slide (Fig. 2), arranged mainly at the margin or ends of the rays. Also the homogeneous content of the oil cells is perfectly silicified, as shown by the photographs. The peculiar arrangement of the oil cells and the structure of the tyloses of the vessels are presented by Fig. 7 in Plate XIV.

Note: The structure of the stem No. 13 found at the right side of site No. 1 at Ipolytarnóc agrees with that of the stem washed out above the site of Kubinyi. On the cross structure pictures of one of the fossil stems examined it clearly appears that the intervals between the solitary or radially arranged vessels are filled with tracheids of comparatively thin walls and narrow lumina, and wood parenchyma and xylem fibres, respectively. This structure is greatly suggestive of *Aniba roseadora* Ducke indigenous in Central America, as pointed out in the description of the fossil of Ipolytarnóc (Greguss 1954).

Schönfeld (1933) deals with the xylotomy of *Laurinoxylon linderoides*. A detail in Fig. 2 attached to his study almost completely agrees with the structure of the tracheid and oil cells of the fossil discussed, while it differs in other details. The fine structure of *Aniba roseadora* exhibits a close similarity to that of the silicified wood. Rásky (1960) mentions from this site of fossil plants a great number of leaf imprints belonging to the *Lauraceae.*

Süss (1960) dealt with the fossil in detail and described it more exactly as *Laurinoxylon aniboides* Greguss em. Süss.

L. Ipolytarnóc; **A.** Burdigalian.

Laurinoxylon müller-stollii Greguss em. Süss

Plate XIV, Figs 4–9.

Descr. **C.** (Fig. 4). Parts of this resemble *Laurinoxylon aniboides* discussed above. Paired pores also appear here distinctly, though the single vessels are rather frequent. The intervals between the vessels are filled with compressed xylem fibres.

T. The ray and trachea structures are clearly seen. The rays are in general 10–15 layers high, mostly biseriate; the oil cells adjoin to their ends as marginal cells. The interior of the tracheids is filled with loose tyloses (Fig. 5). The finer structure of the rays is shown in higher magnification in Fig. 6 of Plate XIV.

Müller-Stoll (1951) determined a lignite from the Oligocene as *Laurinoxylon* sp. The photo and description published perfectly agree as to dimensions and structure with the inner structure of the fossil record of Ipolytarnóc. The left side of Fig. 6 represents a single ray structure of the silicified wood of Ipolytarnóc, while in the white field there is the photo of the *Laurinoxylon* sp. of Müller-Stoll. These two are identical in their structures, so we may state that the lignite found in Wiesa bei Kamenz in the GDR and the fossil wood of Ipolytarnóc belong to the same species.

R. The tracheid walls are densely covered by bordered pits, which is a characteristic feature of the *Lauraceae.* Süss (1960) in possession of further comparative materials completed the description of the fossil species, so that its more exact name is *Laurinoxylon müller-stollii* Greguss em. Süss.

L. Ipolytarnóc (Katlan-valley, right side, site No. 2); **A.** Burdigalian.

Laurinoxylon cf. *californicum* (Platen) Süss

Plate XV, Figs 1–8.

Descr. **C.** shows a high degree of creases and partial disorganization. The annual rings are visible, though not conspicuously, the vessels in them are in general solitary, and only seldom multiples of two or three pores occur in the radial direction (Figs 1 and 2). Their radial diameters are 70–90 μ, their width 50–60 μ, but they may be larger or smaller as well. Vessels wider than 120–150 μ hardly occur. Often enough a dark content is found in the vessels. Owing to a high degree of disorganization, the elements of the ground tissue can hardly be distinguished from one another. The 2–4 cell layer wide rays run sinuously, mostly flanking one member of vessel each. The separating cell wall of the paired pores falls in a tangential direction (Figs 1 and 2).

T. Because of the strong compression, no characteristic tangential details could be photographed. The tiny bordered pits in the tracheid walls are generally located beside each other, their aperture is horizontal (left side of Fig. 8), transgredient. Only simple and no scalariform perforation was observed in the tracheids. The vessels with wider lumina frequently contain tyloses. Fine spiral thickening is found in the walls of some tracheids. The direction of the spirals could hardly be followed, owing to the compression of the vessels. The rays are generally of 2–3 cell layers, but 4 and exceptionally 5 cell layers also occur (Figs 3, 4 and 5). On the upper and lower parts of some rays, characteristic conic or bottle-shaped oil cells are situated, on the top of which the cell wall is more strongly thickened, though also the lateral walls are thick enough. Most of them are 60–70 μ high, but some attain a height of even 150 μ. Some cells seem to be empty, while others have a darker content. Thusthe tangential structure also shows the characteristics of the *Lauraceae*.

R. The Lauracean character is still more conspicuous, first of all in the shape and structure of the oil cells which, as seen from Figs 7a, b, c, are located at the margins of the rays, and are generally conical when seen radially. The shape and thickness of their walls definitely differ from the structure of *Laurinoxylon hasenbergense* Süss and can be in no way identified with it.

Note: The piece must have originated from a thick stem. This is immediately revealed by the width of the annual rings and the structure. On the exterior of the fossil, strong creases seen also from the sinuousity of the annual rings could be established. It is a well-preserved fossil of yellowish brown colour, completely silicified, from which rather good slides could be prepared. On the piece of stem examined 25 annual rings were counted with the naked eye; the thickness of the single annual rings was about 3–4 mm.

Süss (1960) refers to *L. californicum* and *L. daberi* among the fossil *Laurinoxylons*, the walls of the oil cells of which are thick, while on *L. radiatum* he found cells containing spiral thickenings. Since the oil cells of the fossil described have thick walls, it probably belongs to the form group of *L. californicum*. The record of Zagyvapálfalva differs from *L. daberi* in that it has definite annual ring limits. The fossil described is beyond doubt a *Laurinoxylon*, though different from the Hungarian *Laurinoxylon*s discussed so far. It most probably shows a closer similarity to *L. californicum*, because this too has definite annual ring boundaries.

L. Zagyvapálfalva; **A.** Lower Helvetian.

Laurinoxylon pálfalvyi n. sp.

Plate XVI, Figs 1–9.

Diagnosis: In sectione transversali in texto fundamentali tracheidarum fibrosarum valde conferto tracheae pro ratione parvae, solitariae, vel geminae, paucae. Tracheidae fibrosae in seriebus radialibus ordinatae. Limites stratorum concentricorum locis nonnullis cavernas majores continentium indistincti. Radii medullares stratis 1–3, structura heterogenea. Paries trachearum poris areolatis parvis plene coopertus, perforatione scalari.

Descr. **C.** There is no conspicuous annual ring boundary, and the transition of the annual rings is gradual. However, at some places the vessels with narrow lumina are more concentrated, from which the presence of annual rings (Fig. 1) may be inferred. The wood must have been very compact, since in the dense fibre substance the single vessels, pore pairs or multiples of 3–4 elements are scattered at distances of about 4–10 vessel diameter. The single vessels are somewhat more frequent in the early than in the late wood. The diameter of the vessels is 140 to 150 μ, their cross section angular, at some places compressed. Circular vessels hardly occur.

The tracheids and xylem fibres in the ground substance are arranged radially. Also the cross sections of the tracheids of narrower lumina are generally quadrangular. The xylem fibres in the ground substance are sometimes concentrated in groups, among which parenchyma cells can be observed. This structure is suggestive of the cross section of some genera belonging to *Lauraceae*. By its quite dense ground tissue and scattered single vessels it definitely differs in its cross-section structure from all the other *Lauraceae*.

The fossil has another interesting feature: at some places in the ground substance larger cavities can be observed (Fig. 4). It is possible that these are due to disorganization, perhaps to the fusion of 2 or 3 vessels, but it is not unlikely either that they are some sort of ducts. The more so since very thin-walled parenchyma, or epithelial cells, or perhaps tyloses are seen in the interior of the cavity. The radially running tracheid rows sweep round the cavity archedly and do not break off before it (Fig. 4).

T. The great number of the rays is conspicuous. These are in general biseriate, 10–15 cells high, continuing on their lower and upper end uniseriately. Very rarely the rays broaden to a width of 3 cells. The marginal cells of the rays are somewhat higher than the interior ones, from which a heterogeneous structure of the rays may be inferred.

Beside the rays, parenchyma cells are rather frequent, which sometimes adhere closely to the rays over a long sector. The cross sections of the ray cells are circles or somewhat elongated ellipses, those of the interior ones are uniform (Fig. 7).

Here and there the cells of the spindle-shaped rays are filled with a dark content which facilitates the detection of the ray structure. This is clearly visible at the places where the single rays are surrounded by longitudinal xylem fibres. No finer details could be established in the fossil which was strongly disorganized.

R. Unfortunately, the finer details could be observed only sporadically; e.g. the tracheid walls were covered by dense and tiny bordered pits arranged either in horizontal rows or alternating. This structure is also suggestive of *Lauraceae*, in which, however, there are no longitudinal ducts. Between the single vessel members, in general a simple, here and there also scalariform perforation can be seen. The scales are at a distance of 5–10 scales from each other (Fig. 9). The interior of the vessels with wide lumina are filled with tyloses. The interior cells of the rays are procumbent rectangles, while the marginal cells are mostly squares or upright oblongs, i.e. the ray is of a heterogeneous structure. In some parenchyma cells 6–8 angular calcium oxalate crystals are found.

The cross section and tangential slide relate the fossil to some recent *Lauraceae*, and even in the radial section there are identical morphological properties. Since scalariform perforations occur also in recent *Lauraceae*, we regard the fossil described as *Laurinoxylon*; I propose to distinguish this fossil under the name of *Laurinoxylon pálfalvyi*, in honour of the Hungarian palaeontologist István Pálfalvy.

Note: The pieces examined show marks of burning. Before silicification they probably were carbonized by a forest-fire or some hot volcanic material.

L. Becske; **A.** Burdigalian.

Laurinoxylon daberi n. sp.

Plate XVII, Figs 1–11.

Diagnosis: Lignum disperse porosum, limites stratorum concentricorum vix conspicui, tracheae in texto fundamentali fibrorum ligni solitariae, vel geminae, vel ex 3–5 poris radios breves formantes. Radii medullares structura plerumque homogenei, in genere latitudine ex 2–3 stratis cellularum compositi, altitudine e 20–25 cellulis constructi, et saepissime in partes medullares unistratosos transeuntes. Cellulae radiorum medullarium oblonga iacentia elongataque, in pariete earum turmae vel series longitudinales pororum simplicium circularium–ellipticorum.

Descr. **C.** Although the annual ring boundary is noticeable, it is a diffuse-porous wood, since there is no great difference between early and late wood. The vessels in the annual ring are single, paired or multiples of 3–6 elements. Most of them are paired pores or single vessels. Their radial diameter is 60–70 μ; their width 40–50 μ; the radial extent of a double vessel is 120–150 μ, its width 40–50 μ. Tyloses are found in the vessels. The ground substance is xylem fibre, with a remarkably great number of solitary longitudinal parenchyma cells. Octahedral calcium oxalate crystals are frequently found in these. The rays 1–3 cell layers wide run sinuously among the large vessels. The walls of the xylem fibres are thick, their lumina sometimes point-like, in other cases slit-like. This structure, though suggestive in many respects of several species of *Lauraceae*, cannot be identified with any of the *Laurinoxylon* known so far. The cross section structure of the fossil definitely differs from that of the species *L. pálfalvyi*.

T. The rays are 1–3 cell layers wide and may reach a height of 20 cells. The cross sections of the cells are circles or, rarely, polygons; in some of them oxalate crystals are found. The broader rays are tapering sometimes to 5–6 cells high uniseriate sectors. Calcium oxalate crystals rather frequently occur in these. The fossil differs from *L. pálfalvyi* also in this respect.

The longitudinal parenchyma cells containing also calcium oxalate crystals, and the xylem fibres closely adhere to the rays.

The rays are not definitely of a heterogeneous structure, since the marginal cells are of the same height as the internal ones, or somewhat higher. Between them run the vessels composed of short members; the bordered pits in their walls are arranged alternately and in oblique rows. The aperture is slit-like. In this respect the structure is highly suggestive of the pitting in the vessels of the other *Laurinoxylons*.

R. The structure of the rays reveals parenchyma cells which are horizontally elongated rectangles. Most characteristically, a number of simple elliptic or circular pits are grouped or aligned in the walls touching the vessels

Note: Figure 9 in Plate XVII represents a ray portion of the species *Laurinoxylon hasenbergense* Süss, which resembles the fossil described, while its cross section structure is definitely different. In this context it should be noted that the fossil of Jobbágyi contains very few oil idioblasts, the conic shape of which can be clearly established and also in this relation it differs from *L. hasenbergense*. The longitudinal parenchyma cells are arranged in zones and rather frequently contain solitary calcium oxalate crystals, which is a general *Laurinoxylon* character. Therefore we propose to class this fossil with the genus *Laurinoxylon*. Since other anatomical properties distinguish it from the other *Laurinoxylon* species known to us so far, we propose to name it as *Laurinoxylon daberi* n. sp. in honour of the eminent German palaeobotanist.

L. Jobbágyi; **A.** Tortonian.

Laurinoxylon süssi n. sp.

Plate XVIII, Figs 1–7.

Diagnosis: Lignum disperse porosum, sine limitibus stratorum concentricorum conspicuis. Tracheae solitariae, geminae, vel ternae–quaternae radios pororum breves formantes. Textum fundamentale e fibris ligni formatum. Circa tracheas parenchyma vasicentrica. Radii medullares altitudine ex 15–20 cellulis, latitudine e 1–2 (3) stratis cellularum constructi, cellulis magnis oleiferis conicis, 140–150 μ magnis marginati. Paries trachearum poris areolatis parvis dense coopertus. Lignum cellulas oleiferas plurimas continens.

Descr. **C.** A diffuse-porous wood without well-defined annual rings, and of a perfectly uniform structure. Its single vessels are of about the same size, their diameter is mostly 140–150 μ. Sometimes 2–3–5 vessels closely adhere to each other and form short rays. Of the paired vessels one is generally smaller than the other (Fig. 3). The ground substance is xylem fibre and wood parenchyma. The 2–3 seriate rays between the vessels and ground tissues run somewhat sinuously. The cross sections of the wood fibres are of various shape, their diameter is usually 12–15 μ. As to cross section structure, the species differs from the previous ones, and only resembles *L. vadászi* (Fig. 3).

T. The rays are in general uni-, bi- or triseriate and 3–16 cells high, of heterogeneous structure, at the edges of the rays oil cells are frequent, both above and below. The interior cells of the rays are 15–16 μ high, while at the margins of the rays the oil cells may reach a height of 140–150 μ. This structure allows to infer *Lauraceae* with the remark that such oil cells occur not only in this family. In this respect the fossil shows some similarity to *Laurinoxylon aniboides* where uniseriate rays are frequent (Plate XVIII, Fig. 2). In the fossil described, however, most of the rays are 2 or 3 cell layers wide (Figs 4 and 5). Rather frequently parenchyma cells adhere to the rays: their length is 80–90 μ, their width 22–23 μ.

R. The *Laurinoxylon* character becomes still more predominant. The interior of the cells is filled with dense tyloses, while their surface is covered with tiny bordered pits (Fig. 6). The height of the ray cells is also on this side 14–16 μ, while that of the oil cells 130–140 μ. The oil cells are located at the margin of the rays almost in a row (Fig. 7). The form of the oil cells is conical. No *Laurinoxylon* of so rich and dense oil content was encountered as yet in the course of investigation. Accordingly the fossil must be some kind of *Laurinoxylon* definitely differing from the previous ones.

Note: The fossil described is suggestive of *Laurinoxylon aniboides*, but differs from it in the width of the rays. Up to a certain point *Laurinoxylon müller-stollii* may enter into consideration, but the fossil cannot be identified either with that or any of the other known forms. To distinguish it, I propose the name *Laurinoxylon süssi* in honour of the eminent expert of the *Laurinoxylon*s.

L. Szokolya, Óhegy; **A.** Helvetian.

The original material is in the Hungarian National Museum under No. 155.

?Laurinoxylon sp.

Plate XIX, Figs 1–9.

Descr. **C.** A diffuse-porous wood with hardly perceptible annual rings. In the ground substance consisting of xylem fibre ducts are running, the vessels are single or paired. A short multiple of 3–4 elements rarely occurs. Both the ducts and the vessels are surrounded by parenchymatic cells (paratracheal parenchyma). The rays are generally 1 cell layer wide, though 2–3 cell layers are also frequent. The cross sections of the xylem fibres are more or less equal and arranged in radial rows, the walls are comparatively thin. The diameters of the vessels are 140–150 μ, the radial extent of two vessels is mostly 290–300 μ. The walls between them are thick, the double wall is 14–15 μ thick. The size of the paratracheal parenchyma cells is 25–30 μ. Similar cells surround the ducts, the walls of which are as thin as those of the surrounding parenchyma cells. Such cross section structure allows to infer the *Lauraceae*.

T. The rays are generally 1–2, very seldom 3 cells wide. They are spindle-shaped, their ends are never elongated to such an extent as to form several storeys of marginal cells. The height of the rays is 2–10 cells, their structure somewhat heterogeneous, because the conical form and size of the marginal cells slightly differ from those of the interior cells, which are generally alternating. The marginal cells of the rays are only uniseriate.

Partly xylem fibres and partly parenchyma cells surround the rays. The interior of the ray cells and mucilage cells is filled with a dark content. The walls of the vessels are covered by very tiny and dense bordered pits.

R. Disorganization made the radial walls of the ray cells and their pitting hardly observable, but the heterogeneous structure of the rays is quite distinct. The perforation of the vessels is simple, the plane of the perforation sustending an angle of 45° to the longitudinal axis. In the vessels tyloses occur.

Note: The cross section structure of the fossil described is suggestive of the *Lauraceae*, partly of *Moraceae* (*Ficus*) and up to a certain point of species belonging to the *Sapindaceae*. The relation with *Lauraceae* is largely supported by the longitudinal mucilage ducts in the wood and by the oil cells aligned at the margin of the rays. Also the ray skeleton agrees with recent *Lauraceae*, but the arrangement of the vessels, the presence of para- and metatracheal parenchyma also allows to infer this family. Since the ray structure could not be exactly established, the fossil is named simply as *Laurinoxylon* sp. According to Andreánszky (1955), in the area of Hungary there were extended laurel forests in the Helvetian, when the climate might have been equable, warm-subtropical.

L. Apátvarasd, Szabótanya; **A.** Helvetian.

?Cinnamomoxylon sp. (No. 1)

Plate XX, Figs 1–4.

C. allows to infer *Lauraceae*. The ray skeleton of *Cinnamomum* almost completely agrees with that of the fossil described. So we cannot be far wrong when distinguishing the fossil within *Lauraceae* as *Cinnamomoxylon* sp.

Note: Rákosi (1959) determined a fossil wood as *Laurinoxylon müller-stollii* Greguss. We had an opportunity to prepare photographs of the slides (Plate XX). Both the cross and the tangential slides show that the fossil actually belongs to some Lauracean genus. The rays are 2–3 cell layers wide, also the oil cells are more or less reminiscent of *Laurinoxylon müller-stollii* without suggesting a full identity.

L. Dorog; **A.** Oligocene.

?Cinnamomoxylon sp. (No. 2)

Plate XVIII, Figs 8 and 9.

T. 2–3 cell wide and 20–40 cell high rays appear, some of which probably resulted from coalescence of two layer rays (Fig. 8). At the margins of the rays oil cells are located the number of which is low, particularly when compared to *Laurinoxylon süssi*. Since, however, oil cells are present also on the radial slide, the diameters of which are 150–160 μ, the wood is similar in its ray structure to the *Cinnamomums*. We propose to mention it only as *Cinnamomoxylon* sp. (Fig. 9).

Note: No useful cross slide could be prepared of the disorganized fossil, but the tangential and radial slides are suggestive of some kind of *Lauraceae*.

L. Mogyoród; **A.** Helvetian.

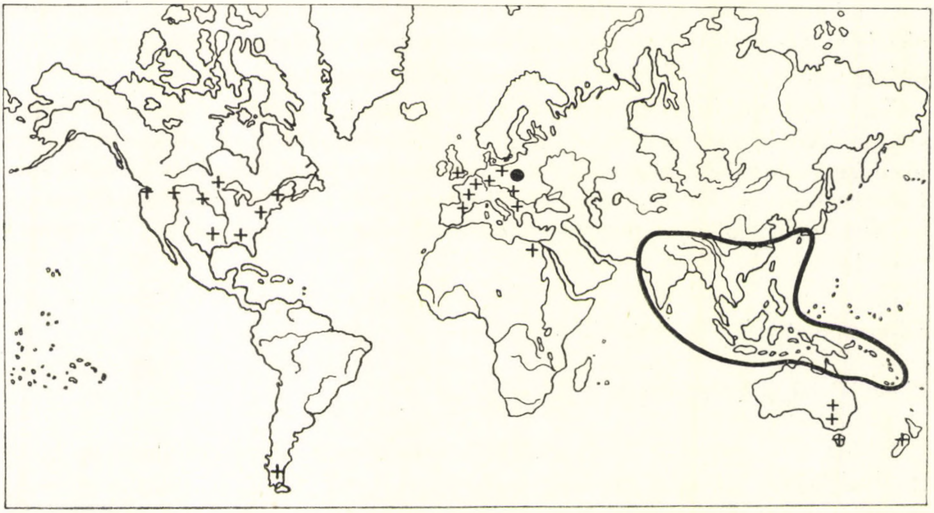
The original material is in the Hungarian National Museum under No. 61. 926.1.

?Cinnamomoxylon sp. (No. 3)

Plate XXI, Figs 1–6.

Descr. **C.** (Fig. 1). The wood is diffuse-porous without conspicuous annual ring boundaries. In the hardly discernible ground substance the vessels are single or paired pores. No multiples with more than two elements could be observed. The single vessels are generally radially somewhat elongated ellipses, their radial diameter is 110–120 μ, their width 70–80 μ. The radial extent of a multiple of two elements is 130, resp. 115 μ. The contact walls are 7–8 μ thick. There occur lysigenous ducts among the vessels, the extent of which is about 150 μ. This structure is suggestive of *Lauraceae*.

T. The ray skeleton is more distinct (Figs 2, 4, 5 and 6). The rays are generally 2–3 cell layers wide and 10–15 cells high. At the margin of almost every ray much larger and higher oil cells can be observed, the height of which sometimes attains even 140–150 μ, while their width is only 30–40 μ. In the bi- or triseriate rays the



Map 2. Recent distribution of the genus *Cinnamomum*. Fossils from the Tertiary proveniences (+) (after Berry). Oligocene and Helvetian sites in Hungary (black spot)

cross sections of the ray cells are generally angular, hexagonal, and they are alternating. The interior ray cells are equal, only the heterogeneous marginal cells differ in size. This heterogeneous ray structure does not present a full evidence of the fossil belonging to *Lauraceae*.

R. Conical oil cells situated at the margin of the rays make it almost certain that the fossil belongs to *Lauraceae* (Fig. 6). On the radial slide, owing to the high degree of disorganization, hardly more than the tyloses in the vessels could be established (Fig. 3). This is also characteristic of *Lauraceae*. In the radial wall of the vessels horizontally arranged fine rifts appear corresponding to the apertures of the tiny bordered pits, which again is a characteristic feature of *Lauraceae*. A scalariform perforation in the vessels can be guessed from the residues of scales running parallel and breaking off here and there.

Note: From the above anatomical features we may conclude that the fossil probably belongs to the family *Lauraceae*. As to the genus, it is most suggestive of the *Cinnamomum* structure, therefore weregard it conditionally as *Cinnamomoxylon* sp.

L. Cserháthaláp (Tornyoshegy point 311); **A.** Helvetian.

?Cinnamomoxylon sp. (No. 4)

Plate XXI, Figs 7–9.

Descr. **C.** The vessels are quite compressed, the oil-holding idioblasts are visible only here and there (Fig. 7). The rays are 1–2 cell layers wide. Owing to the high degree of compression, the structure of the vessels, of the parenchyma cells and xylem fibres could be only guessed.

T. The ray skeleton here and there is clearly discernible. The rays are 1–2 cell layers wide and of heterogeneous structure, at the margins oil cells are frequent, rather often containing idioblasts (Fig. 8).

R. No finer details could be established. So on the strength of the above anatomical features, and particularly of the presence of the high oil cells, the fossil is named as *Cinnamomoxylon* sp. (No. 4). Its ray structure exhibits some similarity also to the *Cinnamomoxylon* discussed previously, but without knowing the cross and radial slides we cannot prove its identity.

L. Budaörs (lower parts of Erdőhegy); **A.** Helvetian.

The original material is in the Hungarian National Museum under No. 61. 875.1.

6. MYRISTICACEAE

Myristicoxylon hungaricum n. sp.

Plate XXII, Figs 1–9.

Diagnosis: Limites stratorum concentricorum obsoleti, in stratis concentricis tracheae in genere solitariae; radii medullares ex 1–2 stratis cellularum constructi, in nonnullis locis etiam radii medullares coacervati. In parietibus tracheidarum pori foveolati uni-biseriati, in tracheis thyllae. In zonis ex radiis medullaribus tracheidisque formatis in pariete radiali cellularum radiorum medullarium 5–6 pori simplices, longi, fissurae similes.

Descr. **C.** The annual ring boundaries are blurred (Fig. 1). The vessels are usually single in the annual rings. In their immediate vicinity, smaller or larger zones of tissue elements in aliform arrangement are seen (Fig. 2). This structure allows to infer *Myristicaceae*, *Sterculiaceae* and *Dipterocarpaceae*. The rays are 1, sometimes 2 cell layers wide, but at some places they appear to be aggregate. Among the vessels with larger lumina also smaller single vessels occur. The diameters of the vessels vary between 150 and 180 μ, their width is somewhat less, so the cross sections are radially elongated short ellipses. Nearly all vessels contain tyloses. Beside the aliform parenchyma, also terminal parenchyma rows are rather frequent in the immediate vicinity of the vessels. The ground substance consists of xylem fibre (Fig. 2).

T. It is clearly visible that the rays are in general 1 cell layer wide (Fig. 4) but at some places also 2, possibly 3 cell layer wide single rays, and sometimes broad aggregates occur (Fig. 3). The rays are 6–8–15, occasionally 20 cell rows high. In the aggregate units not only 1- but also 2–3-seriate rays occur (Fig. 5). Thick-walled fibre tracheids are found among them. In most ray cells a dark cell content is seen. In the walls of the fibre tracheids a simple pitting is visible, the pits are arranged in 1 or 2 longitudinal rows (Fig. 6).

R. The structure of the fibre tracheids is more explicit on the radial slide. The pits in the walls of the fibre tracheids are arranged in 1 or occasionally 2 longitudinal rows by pairs or in a somewhat alternating position. In the endings of some tracheids as many as three pits are beside each other (Figs 6 and 7). The tyloses are clearly visible in the wide vessels (Fig. 8). The heterogeneous structure of the rays is definite. The interior cells are lower than the marginal ones. The horizontal walls of the rays are thin with no conspicuous pitting. The more characteristic is the radial side, since on these walls slit-like narrow pits are aligned which nearly span the height of the ray cells (Fig. 9).

Note: A Lower Eocene stem from Tatabánya is by and large similar to this fossil, as well as to the species *Shoreoxylon mortandranse* described by Ramanujam (1953b). It differs from these, however, in that its rays are in general only 1–2 cell layers wide, while the *Shoreoxylon* described by Ramanujam has also rays of 4–5 and even 6 cell layers. There is a striking similarity between the pittings of the longitudinal tracheids of the two fossils, so the piece of Budakalász may be regarded with some probability also as *Shoreoxylon.*

A most characteristic feature, however, i.e. the special pitting of its rays, definitely distinguishes the fossil from the stem described by Ramanujam. The fossil can be brought into nearer connection with the *Myristicaceae*. This assumption is corroborated by the fact that beside some larger vessels aliform parenchyma fields are arranged, as are in the family referred to, and further, that the ray cells are in general 1–2 cell layers wide. Since particularly the pitting of the ray cells of the fossil perfectly agrees with *Cephalosphaera usambarensis* belonging to the *Myristicaceae*, and also its cross slide is similar to *Cephalosphaera*, the denomination *Myristicoxylon* seems justified. From Oligocene layers *Myristicaceae pollens* have been demonstrated, while Boureau described a *Myristicon* stem from the Sahara.

The representatives of the family *Myristicaceae* are generally tropical trees or shrubs, consequently in Lower Oligocene a perfectly mild warm climate must have prevailed in the present area of Hungary.

L. Budakalász; **A.** Lower Oligocene.

Myristicoxylon bajnaense n. sp.

Plate XXIII, Figs 1–9.

Diagnosis: Lignum vix annulariter porosum. Inter radios medullares e stratis cellularum 1–2 compositos 2–3–4 ordines tracheidarum diametrum 40–45 μ habentium. In ligno meatus horizontales longitudinalesque, 60–120 μ diam. In pariete radiali trachearum pori circulares plerumque bini, vel in seriebus longitudinalibus solitariis dispositi. Parietes radiales cellularum radiorum medullarium poris ellipticis erectis, longitudine cum altitudine cellularum paene aequalibus cooperti; in pariete radiali cellulae unius radiorum medullarium forte 5–6 pori praeter se, nonnunquam forte pori duo alter sub altero.

Descr. **C.** Owing to a high degree of disorganization and silicification all finer details are blurred, besides, the fossil was rather creased; so the cross sections of the vessels and other elements were completely deformed.

T., however, allows some insight into the finer structure of the wood. The rays are generally 1–2 layers wide and 8–15 cells high (Fig. 4). Only the contours and the dark content in some ray cells could be observed.

R. A decisive observation is that the circular bordered pits in the longitudinal wall of the vessels are arranged by pairs and as a rule in 1 or 2 rows situated above each other (Figs 5 and 6). This is highly suggestive of the structure found in *Shoreoxylon.* Still the fossil is not *Shoreoxylon*, because pitting is substantially different, but it almost perfectly agrees with the species *Myristicoxylon hungaricum*, since the pits in the radial wall of the ray cells are elongated and upright ellipses which follow each other at about the same distance as the width of the pits.

Note: Since longitudinal and horizontal ducts are found in the fossil wood, and the pits are arranged by pairs and in longitudinal rows in the vessels, and the pits in the radial wall of the ray cells are upright ellipses, the fossil examined should be ranged with more probability to the *Myristicaceae* than to the *Lauraceae*. It differs from *Myristicoxylon hungaricum*, therefore we propose to distinguish it, after its site, by the name *Myristicoxylon bajnaense*.

The fossil was found at Bajna, in the company of an *Icacinoxylon*. *Icacinaceae* are plants of tropical or subtropical regions. The representatives of the *Myristicaceae* are also inhabitants of warm, tropical and subtropical regions. From the occurrence of the two *Myristicoxylon* fossils it can be inferred that a mild subtropical, perhaps tropical climate prevailed in the area of Hungary in the Oligocene. The presence of the oil cells suggests a dry sunny rather than a moisty environment.

L. Bajna; **A.** Oligocene.

7. HAMAMELIDACEAE

Liquidambaroxylon weylandi n. sp.

Plate XXIV, Figs 1–9.

Diagnosis: Lignum disperse porosum, tracheae in seriebus radialibus altera alteram sequentes. Textum fundamentale e fibris ligni parietem crassum lumenque angustum habentibus formatum. Radii medullares altitudine ex 1–40 cellulis formati, saepissime per totam longitudinem eorum 2-stratosi, structure heterogenei. Perforationes trachearum scalares plerumque in una altitudine dispositae, numerus graduum scalarium 25–30. In pariete trachearum pori oblongum sicut basin habentes oppositi et in seriebus perpendicularibus ordinati. Cellulae radii medullaris heterogenei materiam globulosam resinae similem continentes.

Descr. **C.** represents a diffuse-porous wood, the annual ring boundaries of which can be only suspected. There is hardly any difference between the early and late wood. The vessels are arranged in the mass of xylem fibre in longitudinal rows and not evenly scattered. The cross sections of the vessels are radially elongated polygons or short ellipses. The rays running beside them are 1–2 cell layers wide, the cells are radially somewhat elongated rectangles or squares. The width of a ray cell is 9–10 μ. The radial diameter of the vessels is 70–75 μ, their width 60–65 μ. The wall of the xylem fibres is thick, the lumina are point-like or narrow slits (Figs 2 and 3).

T. The rays are 1–3 cell layers wide; most of them are 1 cell wide and 15–20 cells high. Some 2 cell layer wide rays can reach a height of even 40 cells. In this respect it definitely differs from *L. horváthi*. The cross sections of the ray cells are polygonal and arranged alternately. The marginal cells are much higher than the interior ones, consequently the rays are of a heterogeneous structure. Beside these at some places longitudinal parenchyma chains are seen (Fig. 5).

R. Numerous scalariform perforations are arranged at about the same height. The number of the scales is in most cases 18–30, they often branch off furcately and are at a distance of about 7–8 μ from each other (Figs 6–9). Also in this respect it differs from *L. horváthi* in which the number of the somewhat thicker scales is at most 20.

The heterogeneous structure of the rays is explicit; the marginal cells are higher than the interior ones (Fig. 5). A characteristic feature of this species is that the ray cells are filled with resin granules. The walls of the ray cells are thick, the thickness of the double wall is 8 μ. The bordered pits in the walls of the vessels are horizontally elongated and opposed as a rule in vertical rows (Fig. 8).

Note: Although its cross section structure is suggestive of *Liquidambar*, the fossil differs from other *Liquidambar* species by its resin-like content and ray structure. The vessels are arranged not sporadically but in radial rows. The rays are also higher, and generally 2 cell layers wide, although 3-seriates also occur among them (Fig. 5). To distinguish it from other *Liquidambaroxylon*s, we name the fossil after the eminent palaeontologist as *Liquidambaroxylon weylandi* n. sp.

L. Szécsény; **A.** Helvetian.

Liquidambaroxylon horváthi n. sp.

Plate XXV, Figs 1–9.

Diagnosis: Lignum disperse porosum, limites stratorum concentricorum obsoleti, vel aegre visibiles, radii medullares in latitudine ex 2–3 stratis cellularum constructi, sectio transversalis trachearum semper polygonalis, textum fundamentale e tracheidis fibrosis formatum. In pariete trachearum pori areolati oppositi 2–3-seriatique. Perforatio scalaris, gradus usque 20 habens. Cellulae radii medullaris similes rectangulis jacentibus. Pori oppositi in locis nonnullis gradatim in perforationem scalarem transeuntes.

Descr. **C.** A diffuse-porous wood, the annual ring boundaries of which are hardly or not at all perceptible (Figs 1–3). They are indicated by vessels of somewhat narrower lumina. It is a remarkable property of the vessels that their transverse sections are almost without exception angular. The ground substance consists of thick-walled xylem fibres or tracheids, respectively. The rays run parallel at a distance of 1–2 vessels and are 1–2–3 cell layers wide. No parenchyma cells could be observed in the ground substance. The diameter of the vessels is 60–70 μ, there width about the same. In some cases 2–3 vessels are more closely connected with each other. Then it seems as if they formed short multiples (Figs 1–3).

T. The rays are 2–3 cell layers wide and 15–20, very seldom 25 cells high (Figs 4 and 5). The inner cross sections of the cells are generally penta- or hexagonal. Along the rays, tracheids with narrower lumina are seen. In the walls of the vessels the bordered pits are opposed to each other .

R. The scalariform perforation of the vessels is rather frequent. The number of the scales is 12–15 or may attain 20 in some cases. The scales, sometimes branching, are narrow, there are much wider intervals between them. No simple perforation was observed. The rays are by and large of homogeneous structure, though the marginal cells are somewhat higher than the interior ones. The latter are elongated horizontal rectangles. All three walls have many simple pits. It is interesting to observe at places of perforation of the tracheae how the pits course from this amalgamation into the scalariform perforation (Fig. 8).

Note: The piece of stem examined was exposed in a perfectly silicified condition. Judged from its exterior, it must have originated from a stem of at least 20–25 cm diameter. Its colour is yellowish brown, cavities, probably brought about by some sort of duct, can be observed in its interior. The wood, exposed from a lower Helvetian conglomerate near Kárász in the main valley, was obtained from the collection of G. Hámor.

The interior structure of the fossil is highly suggestive of *Liquidambar*. The cross section photos can be distinguished only with difficulty.

On the tangential side the structure of the rays reveals further similarities. In the fossil the rays are generally 2–3 cell layers wide, while in recent *Liquidambar* also uniseriate rays rather often occur. The greatest similarity is found, however, in the radial structure. The perforation is scalariform in both. The number of scales is by and large the same. There is a gradual transition from the opposed pits into the scalariform perforation. In both of them there is a little beak containing small pits above the scalariform perforation. The fossil shows great similarity to, though not complete identity with, the internal structure of the recent *Liquidambar styraciflua.*

Liquidambar leaf imprints are known from many parts of Hungary. Andreánszky (1959) described such imprints from the Helvetian layers in Egertihamér, while Pálfalvy (1952, 1963) from those of Magyaregregy. Since the fossil described differs from the *Liquidambar* stems treated so far, we name it after the Hungarian botanist Prof. Horváth, *Liquidambaroxylon horváthi.*

L. Kárász, Fővölgy; **A.** Helvetian.

Liquidambaroxylon kräuseli n. sp.

Plate XXVI, Figs 1–9.

Diagnosis: In texto fundamentali ex tracheidis fibrosis formato tracheae magnitudine aequales, dispersae; radii medullares latitudine 1–3-cellulares, altitudine 1–20-cellulares, structure heterogenei. Pori simplices cellularum parenchymae longitudinalis plerumque 1-seriati. Gradus perforationis scalaris laxe dispositi, nonnullis locis ramificantes.

Descr. **C.** A comparison with the previous fossils suggests some *Liquidambar.* The cross-slide structure shows the wood definitely diffuse-porous, since the solitary vessels are distributed almost evenly in the annual rings and on the annual ring boundaries; paired pores occur in the rarest cases. There are no conspicuous annual ring boundaries, but at some places they become perceptible by the smaller xylem fibres and the denser vessels. The intervals of the vessels are filled with thick-walled xylem fibres, their lumina are point-like or short slits. The cross sections of the vessels are angular, their radial diameters 45–50 μ, their widths about the same. The rays run at a distance of 1–2–3 vessels and are 1–2 cell layers wide (Figs 1 and 2).

T. The rays are 1–2 cell layers wide and at the most 10–15 cells high. In this respect it definitely differs from the two previous species. The cross sections are polygonal, the walls are thick, in some of them a dark cell content was found. The rays are mostly heterogeneous, since the marginal cells are much higher than the internal ones. The diameter of the former ones may reach a height of 70 μ, while the internal cells are hardly higher than 15–20 μ. Morphologically they are perfectly similar to each other and of the same size (Fig. 4).

R. The heterogeneous structure of the rays is distinctly seen. The height of the internal ray cells is 15–20 μ, while the terminal ones are, as a rule, much higher, 70 μ (Fig. 5). Longitudinal parenchyma cells rarely occur in the wood; there are tyloses in the vessels, and the surface is covered with tiny bordered pits. The perforation of the vessels is scalariform, the number of the scales being 10–12. They are comparatively thick and follow each other at a distance of 9–10 μ, so in 31 μ there are 3 scales. Above the perforation there is a short beak. By this characteristic feature, the species substantially differs from the previous *Liquidambar*s and from those to be discussed later. Beside the scalariform perforation, in some cases also simple perforations occur. The wall of the ray cells is thick, 7–8 μ, with a dense simple pitting (Fig. 5).

Note: The cross section, as well as the tangential and radial structure of the fossil allows to infer *Liquidambar*. Since the fossil described is also suggestive of *Liquidambaroxylon horváthi*, but is still somewhat different from it, we consider it as a new species. Therefore we name it after the eminent German palaeontologist as *Liquidambaroxylon kräuseli* n. sp.

L. Nógrádszakál; **A.** Sarmatian.

The original material is in the Hungarian National Museum under No. 61.415.1.

Liquidambaroxylon mägdefraui n. sp.

Plate XXVII, Figs 1–9.

Diagnosis: Lignum perfecte disperse porosum, limites stratorum concentricorum haud discernibiles, tracheae polygonales, textum fundamentale earum e fibris ligni compositum, radii medullares saepissime 1-stratosi, raro 2-stratosi, altitudine ex 1–40 cellulis formati, perforatio scalaris gradibus scalaribus usque ad 40, forte bifurcatis, interdum reticulatis, perforationes plerumque in eadem altitudine dispositae, supra perforationes termini rostriformes sat crebri. In pariete trachearum pori circulares, vel elliptici, vel horizontaliter elongati. In zonis ex radiis medullaribus tracheidisque formatis pori circulares, vel ellipticae, vel botuliformes.

Descr. **C.** The annual ring boundary can be only suspected in the diffuse-porous wood. The cross sections of the vessels are radially somewhat elongated, mostly angular, elliptic or circular. Their radial diameters are 40–50 μ, their widths 35–40 μ. The wall of the xylem fibres filling the intervals between the vessels is generally thinner than was seen in *Liquidambaroxylon horváthi*, but the habitude is in every respect suggestive of *Liquidambar* (Fig. 2).

T. The rays are generally uniseriate and 1–35 cells high (Figs 3 and 4). The high rays broaden on the one end and partially in the middle at some places to 2 cells. In this respect the wood positively differs from *Liquidambaroxylon horváthi* and the other stems described so far as *Liquidambaroxylon*s, the rays of which are generally 2–3 cells wide (Figs 3 and 4).

R. There is a difference also in the perforation of the vessels. While in *L. weylandi* the scales are comparatively thin and their number not more than 10–15, in the stem described the number of the scales may amount to 40, they are broader but the intervals between the scales narrower. The distance between the scales is 6·5–7 μ, they are often branching, sometimes almost reticular.

The pits are circular, elliptic or of procumbent stick shape in the cross fields. Even 6–8 simple pits occur in a cross field (lower left corner of Fig. 9).

Note: As regards cross section structure, and the relation of vessels and xylem fibres to each other, this fossil definitely differs from that of Nagyvisnyó, but also from *Liquidambaroxylon horváthi*. One of its most characteristic features is the scalariform perforation. This and the structure of the cross fields distinguish it from the *Liquidambaroxylon*s described so far. The difference is also verified by the photos compared. We designate the new species as *Liquidambaroxylon mägdefraui* after the eminent German palaeontologist.

L. Szarvaskő, Almárvölgy; **A.** Helvetian.

The original material is in the Hungarian National Museum under No. 61.932.1.

Liquidambaroxylon cf. *speciosum* Félix

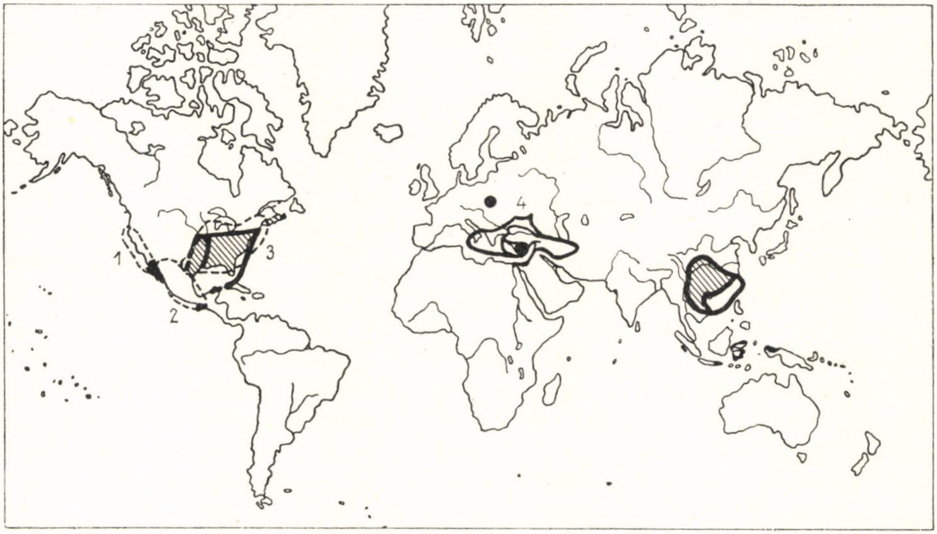
Plate XXVIII, Figs 1–9.

Descr. **C.** In 1 to 50 magnification the annual rings are so blurred that no definite boundaries can be distinguished (Fig. 1). In a diffuse-porous wood the single vessels are more or less evenly distributed in the annual rings. The cross sections of the vessels are angular, rounded cylindrical vessels hardly occur (Figs 2 and 3). Its cross structure is rather suggestive of that of the *Liquidambar* from Kárász. The rays run at a distance of 1, at most 2–3 tracheids, comparatively densely beside each other. In general, they are 1–2 cell layers wide. Owing to creases, the rays are here and there sinuous, while at other places run radially.

T. The rays are generally uniseriate, but bi- and triseriate ones often occur, too. Their height is 20–25 cells. The cross sections of the ray cells are circular or upright ellipses in the uniseriate, and alternating in the biseriate rays so that one ray cell is inserted between two (Figs 4 and 5). Between the rays are arranged the xylem fibres and the vessels in which the perforation is in most cases scalariform (Figs 8 and 9). The surface of the vessel members is covered with opposed pits, even 3–4 pits may occur in the width of one vessel (Fig. 7), but sometimes only 2 long pits fit together. Near the perforation rather often there is only 1 long pit which spans the tracheid entirely (Fig. 6).

R. The arrangement of the opposed pits is still more conspicuous in the walls of the vessels. The scalariform perforation is frequent also on the radial side. The number of the bars of perforation is fluctuating between 20 and 30, some bars may branch furcately (Figs 8 and 9). In the walls of the narrow tracheids the simple pits are aligned in one row, at some places two occur beside each other (Fig. 7). In this respect the fossil somewhat resembles *Platanus*, *Magnolia* and *Liriodendron*, but also differs from these since the scales in the fossil described are much broader than in *Magnolia*, which makes it slightly similar to *Icacinaceae*. Also the heterogeneous structure of the rays is suggestive of *Liquidambar* (Fig. 7).

Note: While in the fossil of Kárász the rays are for the most part bi- or triseriate, here the uniseriate rays prevail. There is also some difference in the perforation. In the fossil of Kárász the number of the scales is 16–20, while here their number may be 30, and the scales are also somewhat thicker (Figs 8 and 9). A difference is shown also by the heterogeneous structure of the ray. In our fossil the marginal cells are upright rectangles. In the stem from Kárász the interior ray cells are elongated rectangles and they are somewhat lower than in the fossil of Nagyvisnyó.



Map 3. Recent distribution of the genus *Liquidambar* (hachures). Tertiary sites in Hungary (black spot)

Félix (1887) described this species from Megyaszó. His determination seems to be correct, because the anatomical drawings from the slides by and large agree with the anatomical structure of the recent *Liquidambar styraciflua.* Andreánszky (1959) also determined a *Liquidambaroxylon* species from Mikófalva. He publishes two photos of the tangential and radial slides, but withholds the most characteristic one on the radial slide. As to the determination, he states that in the fossil at some places the rays are aggregate. It is, however, a well-known fact that there are no aggregate rays in *Liquidambar.*

The photos published by Horváth (1954) on the *Liquidambaroxylon* of Megyaszó are not characteristic of *Liquidambar.* In our opinion both the tangential and the transverse slides are more suggestive of some *Rosaceae* than of *Liquidambar.* This assumption is supported by Horváth stating that "in the fibre tracheids of the fossil spiral thickenings can be observed". As far as we know, there are no spiral thickenings in the vessels of "fibre tracheids" of *Liquidambar styraciflua;* for this very reason the fossil cannot be *Liquidambaroxylon.*

The width of the rays of *Liquidambar*s is 1–2 cells, while in Fig. 1 published by Horváth—which is not transverse but tangential slide—there are 3–4–(5)-seriate rays; such do not exist in *Liquidambar.* On the other hand, in Fig. 8, whose caption is also erroneous, only uni- to biseriate rays are seen.

L. Nagyvisnyó; **A.** Helvetian.

Liquidambaroxylon cf. *styraciflua*

Plate LXVII, Figs 7–9.

The fossil studied has been collected by L. Bartkó. It is silicified to the point of being almost glass-like in section, and so much disorganized that some portions are entirely unfit for examination.

Descr. **C.** shows the characteristic image of *Liquidambar.* The annual ring borders are very vague, indicated by a few layers of slightly flattened wood fibres. It is a scattered-pore wood, the vessels in the annual rings are typically single, usually hexagonal to octagonal in cross section. The interstices between the vessels are filled by bundles of thick-walled wood fibres with a few thin-walled parenchyma cells scattered among them (Fig. 7). The pith rays are 1 or 2 cell layers wide, a width of 3 cell layers is rare. 3-layered rays somewhat widen at the annual ring border (Fig. 7). Beside the tall pith rays the scalariform perforation of the vessels is another frequent and typical feature (Fig. 9). The number of ladder steps is 20 to 40. The radial structure also resembles that of living *Liquidambar styraciflua.* Perforations fairly often occur at identical levels in adjacent vessels. The longitudinal wood fibres have thick walls, and very narrow, almost slash-like lumina. The inner pith ray cells are rather procumbent, the outer ones rather upright, both are rectangular.

T. Pith rays are seen to be 1 or 2 cell layers wide, 35 to 40 cells tall. The latter dimension is often due to the coalescence of two pith rays lying in the same vertical line (Fig. 8). The ray cells in question are usually circular, the corner cells are upright, i.e. some pith rays are of a heterogeneous structure. Parenchyma cells are thin-walled. Our specimen most resembles living *Liquidambar styraciflua* L., wherefore it may be designated *Liquidambaroxylon* cf. *styraciflua*.

L. Sámsonháza; **A.** Helvetian.

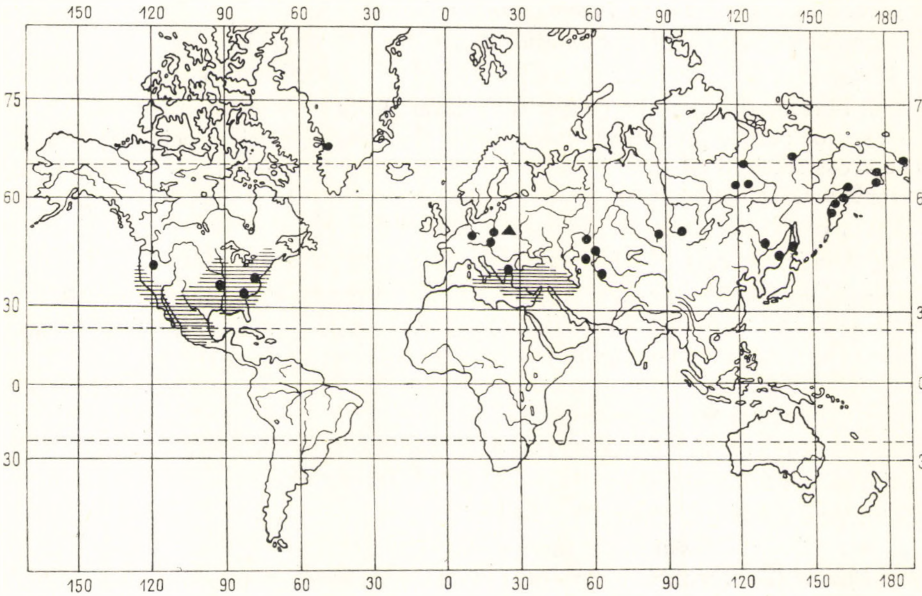
8. PLATANACEAE

Platanoxylon sp.

Note: Andreánszky (1959) determines a *Platanoxylon* remain from Mikófalva, though not convincingly enough because he states that "the perforation of the vessels is simple" and "no scalariform perforation was observed in the wood". He also states that there are higher and lower ones among the ray cells, that is the rays are heterogeneous, while according to Metcalfe and Chalk (1950) the platans have homogeneous rays and not only simple but also scalariform perforations. Andreánszky does not refer to the pitting of the vessels either. Nevertheless we mention it as a record.

Félix (1887) describes the species *Plataninium regulare* from Budafok. This fossil was exposed from the Helvetian. On the ground of the descriptions and drawings it cannot be quite safely regarded as some kind of *Platanoxylon*, still we mention it as a record.

L. Mikófalva; **A.** Sarmatian.



Map 4. Recent distribution of the *Platanaceae* (hachures). Tertiary sites (black spots), in Hungary (triangle)

9. ROSACEAE (see pp. 11, 14)

10. LEGUMINOSAE

Albizzioxylon hungaricum n. sp.

Plates XXIX, Figs 1–9; XXX, Figs 10–18.

Diagnosis: In texto fundamentali e fibris ligni formato tracheae dispersae et sat frequenter solitariae. Strata concentrica tenuia. Parenchyma vasicentrica propria: cellulae parenchymae circa tracheas alaeformiter dispositae.

Descr. **C.** A wood with scattered pores, the annual ring boundaries are hardly observable. The vessels are single, paired or at most multiples of three to four members. They are surrounded in most cases by aliform parenchyma, the wings sometimes merge and are mostly arranged parallel to the annual ring boundary. The parenchyma layers are often alternating with xylem fibre layers. The vessels are comparatively dense, their cross sections circular or radially somewhat elongated ellipses. The ground tissue of the xylem fibres is thick walled, the lumina almost point-like, while the cross sections of the vasicentric parenchyma and parenchyma band cells are of wide lumina and thin walled.

The rays are 1–4 cell layers wide and proceed radially somewhat sinuously among the vessels. By the cross section structure the fossil examined must be regarded as some kind of *Leguminosae*, primarily *Acacia*, but also other genera (*Campsiandra*, *Terminalia*, *Ormosia*) may enter into consideration.

T. shows a different structure when the plane of section proceeds through the xylem fibre or through the parenchyma layer. In both cases the rays are 1–5 cell layers wide and comparatively low, sturdy, their greatest height being 20–25 cells. The cross sections of the ray cells are rounded or hexagonal. The longitudinal parenchyma cells and xylem fibres run along the rays. In some parenchyma cells calcium oxalate crystals are arranged. This broad ray structure greatly reminds us of *Acacia*, the rays of which can be even 3–4 cell layers thick as established by Ramanujam (1953b) for *Acacioxylon indicum*. The cross and tangential sections of *Acacioxylon indicum* and of this fossil show such an agreement that we may regard the fossil as belonging to the form group of the genus *Acacia*.

R. The homogeneous ray skeleton is manifest. The ray cells are horizontally elongated rectangles, their height is 22–26 μ, they sometimes contain calcium oxalate crystals, which also occur in the longitudinal parenchyma cells. The walls of the vessels are covered by dense and tiny bordered pits, their borders are hexagonal, their apertures generally slit-like.

Note: Since the fossil in all three slides fully agrees with the *Leguminosae*, we might name it according to Kräusel (1956) *Leguminosaeoxylon*. Since, however, it shows a great similarity to *Acacia*, first of all to *Acacioxylon indicum*, we might call it *Acacioxylon*, too. According to Ramanujam (1953b) the width of the rays in the fossil referred to is only 1–2–(3)-seriate, while in the stem of Szurdokpüspöki rays with 4–5 layers are rather frequent. Also the dimensions of the vessels and the heights of the rays show some difference. Since, however, the fibre tracheids are septate, which according to oral communication of Mädel is more characteristic of *Albizzia*, we propose to designate it with the name *Albizzioxylon hungaricum.* On the same grounds Ramanujam (1953b) regards one of the fossils as *Albizzia.*

L. Szurdokpüspöki; **A.** Tortonian.

The original specimen is in the Hungarian National Museum under No. 142.

11. DIPTEROCARPACEAE

Shoreoxylon pénzesi n. sp.

Plate XXXI, Figs 1–9.

Diagnosis: In sectione transversali limites stratorum concentricorum nulli, vel obsoleti. Textum fundamentale tracheis solitariis, geminis, vel ternis, et tunc radios breves formantibus. Praeter tracheas parenchyma terminalis aliformiter efformata. Radii medullares 1–2, cum exceptione 3, strata cellularum in latitudine continentes, structura heterogenei. Membra trachearum perforatione simplici et apicibus rostriformiter productis sese accommodantes. In pariete tracheidarum pori simplices gemini, vel terni, quaterni praeter se dispositi. Cellulae internae radii medullaris rectangulares, longe porrectae, cellulae extremae quadratae, vel erecto-rectangulares, in internis saepissime materiam colore obscuram continentes.

Descr. **C.** shows no conspicuous annual ring boundary. The vessels are single, to a lesser extent paired or multiples of 3–4 members (Figs 1–3). The rays are narrow, 1–2- occasionally 3-seriate and a narrow ray extends along almost each great vessel. The radial diameters of the vessels are 100–130–180 μ, their widths 70–90 μ, the cross section of the single vessels is in general a radially somewhat elongated ellipse. The radial diameter of a three membered multiple is about 300 (120 + 90 + 80) μ. The cell walls are comparatively thick, the thickness of two cell walls being 10 μ. The direction of the separating walls is tangential. The ground tissue consists of xylem fibre wood parenchyma and fibre tracheids. From the sides of the single vessels or multiples of three with large lumina, terminal parenchyma bands hardly 1–2 cells wide proceed in a tangential direction. Here and there aliform parenchyma fields are arranged beside the vessels, which greatly reminds us of *Dipterocarpaceae* and *Shorea.* In some vessels the tyloses distinctly appear (Fig. 3).

T. The rays are generally biseriate, but uniseriate ones are also rather frequent (Fig. 4). Their height is 20–25 cells, the marginal cells are somewhat higher than the interior ones. The cross sections of the rays are circles or slightly elongated ellipses. Their height is 25–30 μ, their width 25–28 μ. The terminal cells reach a height of 40 μ. The cross sections of the cells in the biseriate rays are angular and alternate (Fig. 4). In some ray cells there is a dark content. In the longitudinal vessels a great number of tyloses are seen (Fig. 5). Between the vessels there are thick-walled fibre tracheids in which, owing to the high degree of disorganization, the pits can be only suspected.

R. The vessels are 280–300 μ wide. The perforation is simple. Some parts are tapering and fit together with beak-like ends and with simple perforation (Fig. 6). In the walls of the vessels the bordered pits are alternating. The same thing can be observed in the vessels with narrower lumina (left side of Fig. 7). This structure is greatly suggestive of *Shoreoxylon* in whose tracheids the bordered pits are arranged according to a similar pattern. Beside the vessels, parenchyma cells and xylem fibres or fibre tracheids are found.

The heterogeneous structure of the rays can be definitely recognized (Figs 8 and 9). The interior ray cells are horizontally elongated shorter or longer rectangles, while the terminal cells are upright rectangles or squares. Some of both the interior and marginal cells are filled with a dark content, while others are filled with tiny rounded grains, to all probability reserve starch grains. No spiral thickening occurs in the wood and in the vessels.

Note: The anatomical properties are highly suggestive of *Shoreoxylon*. The greatest similarity prevails with the species *Shoreoxylon holdeni* described by Ramanujam (1953b). While, however, in *Shoreoxylon holdeni* almost exclusively great single vessels occur, in the fossil described paired and even multiples of three are frequent enough, and in the walls of the vessels with wide lumina 3 and even 4 simple pits can be found; therefore we propose to distinguish this fossil by the name of Dr. Antal Pénzes, the eminent Hungarian botanist.

L. Budafok (Sashegy); **A.** Helvetian.

Shoreoxylon sp.

Plate XXXII, Figs 1–9.

Descr. **C.** The annual ring boundaries can be suspected only (Fig. 1). The vessels are single, paired pores or multiples of three or four. The radial diameters of the vessels are 250–300, their widths 200–210 μ. One pore pair extends to 370 μ, so each vessel to about 180 μ. The wall thickness of 2 vessels with wide lumina is 10–12 μ; in the walls dense simple pitting is seen. The vessels are mostly filled with tyloses (Fig. 2). The 1–2-seriate rays are meandering among the vessels, owing probably to compression. The rays are comparatively dense, they often appear as if they were aggregates. The cross sections of the cells of the ground tissue cannot always be definitely distinguished, but from the sides of most tracheids aliform terminal parenchyma bands are branching. The cross section structure is greatly suggestive of the *Shoreoxylon* of Budafok.

T. still more corroborates this view (Figs 4, 5, 6 and 7). The rays are in general uni- or biseriate, but in some cases they may broaden to 3 and even 5 cell layers (Fig. 7). The cross sections of the multiseriate internal ray cells are angular, while those of the biseriate ones are generally hexagonal and alternately arranged. The high degree of compression is best shown by the rather frequent tangential details occurring immediately beside the radial ones. The height of the ray cells is 20–22 μ, that of the marginal ones reach even 30–40 μ, so the ray structure is heterogeneous. In some ray cells a dark cell content is seen. Finer details could not be established in the disorganized fossil (Figs 8 and 9).

Note: The cross and tangential sections allow to infer some kind of *Dipterocarpaceae*, similar to the *Shoreoxylon* described by Ramanujam (1953b). But our fossil has more 1–2 seriate than 5–6 cell layer wide rays while in the fossil of Ramanujam the broader rays are more frequent. In this respect our fossil shows a closer similarity to *Dipterocarpoxylon indicum* Ramanujam. Since no finer details could be established in the structure of the rays and because the ray structure of the fossil is 2–3 cell layers wide, which is a property of the *Shoreoxylon*s, it should be classed to these.

Many genera belong to the *Dipterocarpaceae* (*Hopea*, *Palabocarpus*, *Monotes*, *Dipterocarpus*, etc.) the cross section structure of which, to a certain extent, agrees with that of the fossil described—so does also the structure of the *Shorea*—,however, as to its finer details, it cannot be compared with any of these. Perhaps it could be brought in closer connection with *Shoreoxylon* sp. because tripartite pore multiples occur also in this species, exactly as in the fossil examined.

L. Rudabánya; **A.** Pannonian.

Shoreoxylon cf. *holdeni* Ramanujam

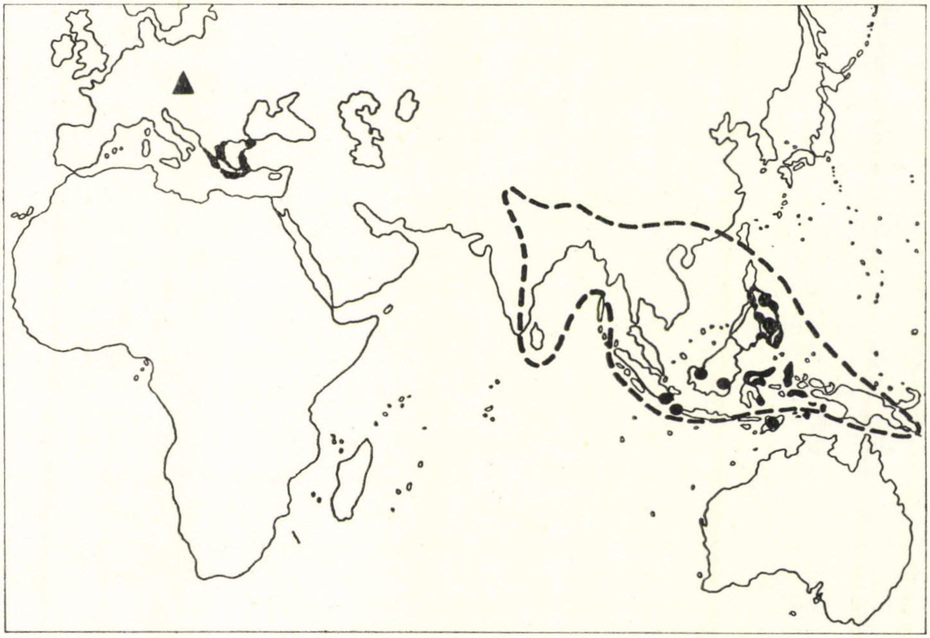
Plate XXXIII, Figs 1–7.

Descr. **C.** The vessels in the ground tissue are generally single; beside them the 1–6-seriate rays are meandering, as a result of compression. In each of the single vessels tyloses occur. From the side of the vessels perpendicularly to the rays parenchyma fascicles course parallel to the annual ring boundary, i.e. terminally; the vessels were surrounded by a vasicentric parenchyma. This picture greatly resembles the structure of *Diospyros*, *Carya* and *Pterocarya.* The diameters of the tracheae are 130–200 μ, their cross sections generally circular. The ground tissue consists of more or less homogeneous xylem fibres.

This cross section structure is suggestive of *Carya protojaponica* described recently by Watari, but cannot be fully identified with it. The fossil much more resembles *Shoreoxylon holdeni* described by Ramanujam (1955). A comparison of the two photos verifies this assumption.

T. could not be prepared, because the portion examined was very small.

R. Dark resin content is seen in the longitudinal tracheae (Fig. 6). The ray cells of the 8–10–20 cell high rays are more or less isodiametrical or procumbent short rectangles, while the marginal cells are rather upright rectangles. Their interior is mostly filled with a dark content. Tyloses are apparent also here in the tracheae.



Map 5. Recent distribution of the genus *Shorea*. Tertiary fossil sites (black spots). Oligocene sites in Hungary (triangle)

On the surface of the tracheae the borders of pits arranged in parallel rows can be guessed at some places.

Sporadically also longitudinal parenchyma cells can be observed in vertical rows and, as already referred to, in terminal arrangement.

Among the tracheae with wide lumina there are fibre tracheids with narrow lumina whose pitting is by and large similar to that of the vessels. In the tracheid walls the pits are also here arranged loosely, as a rule in two longitudinal rows. The borders never touch each other: there is always a distance of 1/2 to 2 bordered pits between them. The fossil thus definitely differs from the pitting of the tracheids of *Carya*, *Pterocarya* or *Ebenaceae*. This pitting almost perfectly agrees with the structure of *Shoreoxylon holdeni* described by Ramanujam, as shown by the photos taken from the radial structure of the specimen examined.

Note: The conic shape of this 30 cm long and 16 cm thick piece of stem is highly suggestive of the aerating roots of *Taxodium*, but its interior structure permitted no comparison with these. Nor did it exhibit any characteristic xylem structure, because in the broken interior there appeared tiny fern leaf imprints and several tiny pieces of wood with traces of burning. Therefore it is not wholly excluded that the material examined is partly a piece of the infiltered carbonic-silicious rock-rubble fill. We succeeded in examining one of the details and in preparing two slides of it.

The cross section and radial slide structures of the stem portion almost completely agree with those of the *Shoreoxylon holdeni* Ramanujam, therefore we conditionally identify it with this species which also originates from the Lower Eocene. So, similar *Shorea* species may have lived in the area of Tatabánya in the Lower Eocene and in India in the territory of Mortandra.

As far as we know, the genus *Shorea* has not yet been demonstrated from Europe, and thus these records are of special significance. The fossil form shows a great similarity to the *Shorea* species living at present in Eastern Asia, from which we may infer that a tropical-subtropical climate could have prevailed in Tatabánya in the Lower Eocene.

L. Tatabánya; **A.** Eocene.

12. TILIACEAE (see pp. 10, 14, 114)

13. STERCULIACEAE

Sterculioxylon sp.?

Plate XXXIV, Figs 1–6.

Descr. **C.** In the ground tissue the vessels are seldom single, they are mostly paired (Fig. 1). Their diameter is 60–90 μ. One of their characteristics is that they are surrounded by vasicentric parenchyma (Fig. 2) and contain abundant tyloses. The rays are uni- or biseriate and run at a distance of 2–6 fibre tracheids, archedly sweeping round the vessels of wide lumina. At some places also the presence of terminal parenchyma can be suspected.

T. Owing to a high degree of disorganization, the exact structure of the vessels and rays is difficult to establish. The conspicuously homogeneous rays are generally uni- or biseriate; their interior is filled with a dark content. If they are two cells wide, the cells are hexagonal and mutually alternating (Fig. 5). The vessels are not composed of short members and are not barrel-shaped either.

R. Only the direction and the height of the ray cells could be established. The surface of the wider vessels is covered with dense and tiny pits (Figs 3 and 4), the borders of which closely fit to each other. The aperture is a markedly horizontal ellipse or a narrow slit.

Note: Among the fossils of Dorog, Rákosi (1960) determined a *Cassioxylon*. However, the revision of the slides and the new photographs prepared show that it cannot be a *Cassioxylon* but rather some *Sterculioxylon* or *Sapindoxylon*. The *Cassioxylon* discussed by Félix (1887) definitely differs from the interior structure of the fossil of Dorog. Since no finer details can be distinguished, we have to base our determination of the fossil on such rather vague observations as are the absence of annual ring boundaries, the great number of paired pores, the biseriate, comparatively low rays, the presence of the vasicentric parenchyma, and the dense pitting of the tracheids. No spiral thickening, scalariform or simple perforatior could be established; therefore the fossil of Dorog, by a comparison of the photographs, may be regarded conditionally as belonging to the family *Sterculiaceae.*

L. Dorog; **A.** Oligocene.

14. ACERACEAE

Aceroxylon cf. *palaeosaccharinum* Greguss

Plate XXXV, Figs 1–4.

Note: This fossil was described by Greguss (1943b) from the Tokaj mountains. The fossil collected at Füzérkomlós is beyond doubt an *Aceroxylon*, but its wood structure cannot be fully identified with any of the *Acer* species living in Central Europe. It absolutely differs from the species *Acer campestre*, *A. monspessulanum*, *A. platanoides*, *A. pseudoplatanus* and *A. tataricum.*

The arrangement of the vessels and, to a certain extent, the frequency of the pore multiples remind us of *Acer saccharinum*, the rays of which are uni- and more frequently biseriate, though in the fossil the rays are mostly uniseriate. As for the thickness of the rays, it presents closest similarity perhaps to *Acer ginnala*, but in this wood the arrangement of the vessels is different. All things considered, the fossil exhibits closest analogy with the North American *Acer saccharinum.*

Pax (1926) dealing with the distribution of the genus *Acer* established that in Europe the Sect. *Saccharina* was widespread in the Tertiary, also in the Miocene.

L. Füzérkomlós; **A.** Sarmatian.

Aceroxylon sp.

Note: Andreánszky (1959) mentions an *Aceroxylon* from the Miocene collected at Sóshartyán, Nógrád county, which should be referred to as a record.

15. AQUIFOLIACEAE

Ilicoxylon theresiae n. sp.

Plate XXXVI, Figs 1–9.

Diagnosis: In sectione transversali sine limitibus stratorum concentricorum conspicuis. In texto fundamentali fibrorum ligni cohortes bene distincti pororum 6–16. Radii medullares in latitudine 2–6-cellulares, structura heterogenei (cellulae marginales), e cellulis 10–30 superpositis formati. Tracheae perforatione scalari tantum, geminae, vel in radiis brevibus e 3–5 membris constitutis. Prope tracheas et nonnullis locis prope limites stratorum concentricorum parenchyma terminalis. Radii medullares in latitudine 2–5-cellulares, structure heterogenei. Cellulae internae radiorum medullarium rectangulares horizontaliter porrectae, cellulae horum externae quadratae, vel erecto-rectangulares. Tracheae cellulis vasicentricis parenchymae coopertae, poris multis simplicibus rotundis. Tracheae arcuatae poris circularibus, areolatis, ostiola parva, rotunda habentibus coopertae. In texto fibrorum ligni cellulae multae parenchymae longitudinalis.

Descr. **C.** reveals a broad-leaved tree, because multiples of vessels and elements with narrower lumina are arranged side by side. The hardly noticeable annual ring boundary (Figs 1 and 2) is only marked by the narrower lumen of the vessels and of the other tissue elements. Between the broader rays also narrower ones are found, the exact width of which could not be established. The most characteristic feature of the cross slide is that the vessels are arranged in multiples of threes, sixes and tens, mostly forming short rays. The diameters of the vessels are 30–50 μ, their cross sections are angular and most varied in form. Also the cross sections of the fibre tracheids constituting the ground tissue are in general polygonal (Fig. 3). This cross section structure is highly similar to that of the recent *Ilex*.

T. presents the structure of the rays (Figs 4, 5 and 6) which are generally 3–5–6 cell layers wide, and 10–30 cells high (Fig. 6). In some of them the cross sections of the marginal ray cells (Scheidenzelle) are much wider than those of the interior ones, which characteristically testifies to a heterogeneous ray structure (Fig. 4). The cross sections of the ray cells are generally angular and of different lumina. Ray cells of quite narrow lumina may contact also cells with much wider lumina.

Between the rays are meandering vessels and tracheids with narrower lumina and beside these short parenchyma cells are arranged. Horizontally elongated bordered pits are seen in the walls of the vessels and tracheids. On account of their density, these appear as scalariform thickenings and proceed through the whole length of the vessels; the scales branch at some places. These, however, are no real scalariform perforations since the bars of a real perforation are much thinner and narrower (hardly 1 μ wide) than those at the longitudinal walls of the tracheids. For example, 6 bars are contained in 36 μ, the interval between the scales being 5 μ, while the thickness of the bar only 1 μ. On the other hand, the single bars of the scalariform thickenings at the longitudinal walls of the tracheids are 3–4 μ wide, and the intervals between the bars are of the same width (Fig. 9). In the perforations 10–15 scales may occur (Figs 7 and 9). No simple perforation could be observed. In the vessels tyloses are frequent.

R. The heterogeneous structure of the rays is visible, though this presents itself more in the forms of the ray cells. In conformity to the scalariform thickenings of the tracheids, generally 6–8 tiny, mostly rectangular pits are arranged here and there in the cross fields.

Note: The dark brown or greyish-black piece of stem, carbonized probably by volcanic ashes, was exposed in silicified condition from the rhyolite tuff. It must have suffered a strong compression since traces of crease can be observed on it with the naked eye.

The structures of the cross, tangential and radial slides are highly suggestive of *Ilex*. Scalariform perforation and thickening of the vessels definitely differ from *Ilicoxylon* sp. described in the following and so do the height and width of the rays. Therefore they cannot be identified with each other. To distinguish it from the fossil of Füzérkomlós, I name the piece of stem of Vékény *Ilicoxylon theresiae* after my wife, who always readily helped me in my work.

L. Vékény (trench of the north side of the Bányász-út [Miner's Road]); **A.** Helvetian.

Ilicoxylon cf. *aquifolium* Hofmann em. Greguss

Plate XXXVII, Figs 1–4.

Note: The fossil was determined first by Hofmann (1939) as *Ilicoxylon* cf. *aquifolium*. The xylotomy of the same stem as examined by us (Greguss 1943a) precludes *Ilex aquifolium* not only by the arrangement and pitting of the vessels but also by the width of the rays. While in the specimens of the recent species the rays can be 7–8 and even 10 cell layers wide, in the fossil stem in question the rays are 2–3- and only very exceptionally 4- or 5-seriate (Figs 1–4). Also the perforation and pitting of the vessels show a significant difference. Thus the stem can hardly be brought in connection with *Ilex aquifolium*. It may have originated from another species related to *Ilex aquifolium*. Therefore we only mention it as *Ilicoxylon* sp.

L. Füzérkomlós; **A.** Sarmatian.

16. VITACEAE

Vitioxylon megyaszóense n. sp.

Plate XXXVIII, Figs 1–9.

Diagnosis: Lignum disperse porosum, tracheae latae in limite stratorum concentricorum vix conspicuo, iuxtave radios medullares latitudine ex 6–8 stratis cellularum formatos et altera super alteram dispositae. Ante tracheas latas passim tracheidae angustae nonnullae. Tracheae parenchyma vasicentrica circumdatae in tracheis thyllae; nonnulli meatorum laticem, vel materiam gummi similem continentes. Perforatio trachearum simplex, paries trachearum poris foveolatis parvis, orificio horizontali praeditis coopertus. In locis nonnullis areae trachearum elongatae, sicut in genere Vitis L. Radius medullaris heterogeneous, cellulae radii medullaris externae, radios medullare terminantes aliquantulum maiores, quam cellulae internae.

Descr. **C.** As for its vast vessels it may have been a diffuse porous wood of a tree or climbing shrub. There are no definite annual ring boundaries, only the size of the vessels suggests the presence of the annual ring boundary. The vessels apparently dispersed are arranged near the annual ring boundary at about the same height but at the same time radially along the broad rays. The radial diameters of the vessels vary from 70 to 500 μ, so the vessels are almost visible with the naked eye. Their widths also vary from 30–40 to 300–350 μ. Immediately after vessels with wide lumina rather frequent, 1–2 or even 5 vessels of quite narrow lumina follow, in general radially arranged. Most of these are filled with tyloses. Idioblasts containing a mucilaginous substance are frequent among the vessels. It is not impossible, however, that these are essentially tyloses which intrude like tubes into the vessels. In the wood only wide rays are seen, the widths of which are 6–8 or 15 cells, parallel to each other and sinuously meandering among the vessels with wide lumina. Paratracheal parenchyma cells surround the vessels almost as a ring. Some of the vessels are interiorly lined with tube-like protuberances which to all probability are primitive tyloses. These, growing further towards the interior of the vessels, close or fill the interior of the vessel as tyloses. The intervals of the vessels are filled here and there with tracheid groups or, to all probability, parenchyma groupings; on their sides thick-walled xylem fibres are located.

The arrangement of the giant vessels partly in tangential partly in radial rows safely permits to infer *Vitaceae.*

T. The broad rays and the xylem fibres and other elements among them are arranged in longitudinal zones beside each other. The rays are 8–10–12 cells wide and extremely high, their endings can be noticed in the rarest cases. The rays are composed of uniform ray cells, the height of which is 8–10 μ, their width about the same. The marginal cells of the rays are somewhat larger than the interior ones (Fig. 6), which is in a certain respect characteristic of the genus *Vitis*. Between the rays, the vessels with narrow and wide lumina, and the tracheids are meandering. Their walls are covered *Vitis*-like, that is not by horizontally elongated bordered pits running perpendicularly to the longitudinal axis (Figs 7 and 8) but by tiny pits which follow each other alternating or semi-opposed (Fig. 8). The aperture is a horizontal slit. This character does not point to *Vitis* but to the genus *Cissus*, although at the contact of the broad vessels and the ray parenchyma cells *Vitis*-like pits also occur. The finer structure of the fibres could not be established, owing to the high degree of disorganization. In some places the interior of the cells was filled with a yellow resin-like substance which must have been the content of some duct. According to Metcalfe and Chalk (1950), there is such duct in the *Cissus* which is filled with mucilaginous- or resin-like substance. So the tangential slide perfectly agrees with the *Vitaceae*.

R. The broad bands of the high rays are conspicuous; the ray cells in these are partly horizontally elongated rectangles, partly squares or polygons. The vessels are thick walled and the bordered pits in them fit closely together, their aperture is a horizontal slit. The borders are sometimes horizontally elongated and become almost *Vitis*-like (Fig. 7).

Note: The cross section structure of the wood shows definitely a *Vitis* character, so the fossil belongs to *Vitaceae*, named by Metcalfe and Chalk (1950) *Ampelidaceae*, to which the genera *Ampelopsis*, *Cissus*, *Leea*, *Parthenocissus*, *Psedera*, *Tetrastigma* and *Vitis* belong. Of these, on the basis of the cross-section structure, the genera *Psedera*, *Cissus* and *Tetrastigma* enter into consideration. On the other hand, tyloses occur mainly in *Cissus*, *Parthenocissus* and *Vitis*. These two mentioned last do not fully agree with our fossil as to other anatomical features. In *Cissus* the rays are 6–8 cells broad, while in *Psedera* and *Vitis* 15–20 cell wide rays may occur. Longitudinal intercellular canals containing mucilaginous ducts occur also in *Cissus xycioides*, exactly as in the fossil described. So in the last analysis the fossil shows greatest similarity to *Cissus*.

The genera belonging to *Vitaceae* are tropical and subtropical plants and characteristically lianes.

Andreánszky (1959) mentions two *Cissus* species among the fossil plants of Mikófalva. In the same work he describes *Cissus* also from Sály, Nógrádszakál, Eger, Buják, the valley Szelecsi-völgy, etc., and one species under the name *Ampelopsis* cf. *orientalis* from the Sarmatian layers of Mikófalva. The cross-section structure of the silicified wood examined is most suggestive of *Vitioxylon ampelopsiodes* described by Schönfeld (1930) which "stammt aus der Braunkohle des Lettengrabes in der hohen Rhön". This similarity reassures us as to the correctness of our determination.

We name the fossil after its site as *Vitioxylon megyaszóense*.

L. Megyaszó; **A.** Lower Pannonian.

The original material is in the Hungarian National Museum under No. 61.906.1.

17. ICACINACEAE

Citronella cf. *mucronata* D. Don

Plate XXXIX, Figs 1–11.

Note: The greyish-brown silicified piece of wood as big as a fist came to light from Ipolytarnóc from a gully near the site of the shark's tooth, from where also some fossil footprints were recorded. Originally the fossil might have been of the thickness of an arm as can be inferred from the direction of the radially arranged rays and the arch of the annual ring boundaries. The anatomical data furnish evidence enough for the determination of the genus. Shilkina (1958) published three photos of the species *Citronella* cf. *mucronata* which also supplied points of departure for comparison. The most characteristic trait was presented by the pitting of the longitudinal vessels and the structure of the scalariform perforation. As verified by Figs 1 and 2, the scalariform perforation in the fossil of Ipolytarnóc perfectly agrees with the structure of *Citronella* cf. *mucronata*. Very little doubt is left as to their identity. Our assumption is further corroborated by the structure of the longitudinal tracheids. The pitting in the vessels is also similar, though in the *Citronella* horizontally situated bordered pit sets can be observed at some places among the bordered pits. These definitely differ from the pitting of the plane trees, as regards the size of the borders and the structure of the aperture. So the fossil examined agrees with the *Citronella* cf. *mucronata* D. Don recorded by Shilkina with photos.

The *Citronella* or *Villaresia* are living at present in the Indo-Malaysian islands and in Australia, Brasilia, Paraguay, Argentina and Chile. They are generally small trees and shrubs.

L. Ipolytarnóc; **A.** Burdigalian.

Icacinoxylon citronelloides Shilk.

Plate XL, Figs 1–9.

Note: The cross-section structure shows the fossil examined to be similar to *Platanus* or *Magnolia*. The tangential structure is also suggestive of the plane trees or magnolias. However, at the edges of the thick rays where they are suddenly tapering, the rays continue at a height of 5–6 cells and in a width of 1–2 cells, and these terminal ray cells are at least twice as high as the interior ones, which verifies a heterogeneous ray structure, while that of the platans is homogeneous, according to Metcalfe and Chalk (1950).

The greatest difference as against the platans is, however, that fine spiral thickenings are running in the vessel-members of the fossil, while the bordered pits are not explicitly opposed in position. The thickness of the bars, and mainly their number reveal further differences. In platans the number of the bars is 8–16, at most 20, while in the fossil it reaches 40–50 (Fig. 7). Also *Magnolia* and *Liriodendron* have spiral thickenings, but the rays in them are at most 4–5 cells wide. The vessels of the fossil of Tokod present only scalariform, while the plane trees and magnolias not only scalariform but also simple perforations.

Since the structure of the fossil is most suggestive of *Icacinaceae*, we cannot be far wrong when considering it as *Icacinoxylon citronelloides* Shilk.

It should be noted here that my student Rákosi (1960) in his dissertation also mentions an *Icacinoxylon* from Tokod.

L. Tokod-Altáró; **A.** Oligocene.

Icacinoxylon cf. *citronelloides* Shilk.

Plate XLI, Figs 1–9.

Note: The piece of stem examined is brown, where more disorganized yellowish-brown, probably from iron oxide. It is perfectly silicified. The fossil found in the Upper Pannonian layers originates probably from the Lower Helvetian gravel of the Bakony mountains.

The fossil should be regarded as a *Platanoxylon* on account of its broad rays. This, however, is contradicted by the conspicuously heterogeneous ray structure and by the scalariform perforation with many scales. The fossil contains namely two kinds of ray cells: elongated low and square, and high ray cells. A heterogeneous ray structure, besides the broad ray, is suggestive of the *Icacinaceae* referred to, and so are the vessels in which only scalariform perforation occurs, while in the platans also simple perforation is rather frequent. Also a large number of the bars testify to *Icacinaceae.* Shilkina (1958, Plate IV, Fig. 6, Plate V, Figs 1 and 2) publishes microphotographs of *Icacinoxylon citronelloides* which are very similar to, almost identical with, the fossil of Ajka. Therefore we regard the stem conditionally as *Icacinoxylon citronelloides* Shilkina, although in some respect *Platanoxylon* may enter into consideration.

L. Ajka; **A.** Helvetian.

Icacinoxylon cf. *goderdzicum* Shilk.

Plate XLII, Figs 1–9.

Note: The piece originates probably from a Helvetian layer, its colour is yellowish-brown, its surface at some places whitish, which is probably a mark of disintegration.

The fossil ought to be ranged to the *Platanaceae* by the broad rays and the opposed position of the simple pits in the tracheae. It is contradicted, however, by the observation that only scalariform perforations occur in the vessels. Also the number of the scales and the heterogeneous structure of the rays preclude the similarity to platans. In the broad rays of the *Platanaceae* there is only one kind of ray cells, that is the rays are homogeneous, while in the fossil examined (Figs 8 and 9) the ray structure is heterogeneous. Such structure and 18–20 cell wide rays occur in the family *Icacinaceae* with which the silicified stem can to all probability be brought in closer connection.

The fossils of Ajka and Szilvásvárad are both *Icacinoxylon*s. A slight difference only seems to appear in the bars of the perforation. The fossil examined exhibits greatest similarity to *Icacinoxylon goderdzicum*, without showing complete identity.

L. Szilvásvárad (Hangos erdő); **A.** Sarmatian.

Icacinoxylon hortobágyii n. sp.

Plate XLIII, Figs 1–8.

Diagnosis: Limites stratorum concentricorum obsoleti. Radii medullares per latitudinem 1–6–16-cellulares, inter ipsos spatium latitudinis 4–6 trachearum. Tracheae in sectione transversali circulares, vel ellipticae. Textum fundamentale e fibris ligni formatum. Structura radii demullaris heterogenea. Tracheae perforatione scalari tantum, gradibus 5–30. Tracheae poris areolatis oppositis structae, saepe etiam spiraliter incrassatae. Cellulae internae radiorum medullarium longe porrecto-rectangulares, extremae magis quadratae.

The silicified piece of wood is of a dark-black colour, owing probably to burning. It must have been strongly compressed, at least this may be inferred from the slides.

Descr. **C.** The annual ring boundary is not conspicuous. The late wood is marked only by 4–5 flattened tracheid rows, because the vessels here are of somewhat narrower lumina than in the early wood. In the ground tissue consisting of fibre tracheids the vessels are single or paired, and comparatively dense. Somewhat different from the fossils of Nagybátony and Zirc, here the rays seem to be thinner and run more densely. This structure shows at first sight a platan character corroborated also by the slight broadening of the wide rays at the annual ring boundary.

T. The height and width of the rays show a great similarity to the fossils of Mór and Nagybátony. The rays are generally 8–16 cell layers wide and 50–60 cells high, the cross sections of the inner rays are circles or somewhat compressed polygons (Figs 5 and 6).

R. The ray cells are elongated rectangles, the marginal cells squares or short upright oblongs, thus the ray is heterogeneous. There appears some difference as compared with the fossil of Mór and Nagybátony, since in the scalariform perforation the number of the bars is somewhat less here, 8–12 (Fig. 8), but perforations with 18–20 bars also occur. No simple perforation was observed. In the tracheid walls the bordered pits are opposed, i.e. situated beside each other, which is, up to a certain degree, a *Platanus* character. So the fossil is characterized, besides the wide rays, by the position of the bordered pits, by the scalariform perforation and the spiral thickening.

Note: On the basis of the above anatomical properties the fossil is beyond doubt an *Icacinoxylon* that differs from the others. I name the new species after my one-time student Prof. Dr. Tibor Hortobágyi, the eminent algologist.

L. Balaton; **A.** Helvetian.

Icacinoxylon laticiphorum n. sp.

Plates XLIV, Figs 1–4; XLV, Figs 5–8.

Diagnosis: Limites stratorum concentricorum obsoleti. Radii medullares in latitudine 10–18-cellulares, homogenei, textum fundamentale e fibris ligni efformatum. In ipsis radiis latis cava plura longitudinalia, in pariete cavorum cellulis epithelicis. Inter radios medullares latos spatium 10–12 tracheidarum. Tracheae membris brevibus, perforatione scalari, gradibus 15–20, in pariete poris parvis areolatis, in seriebus longitudinalibus plerumque binis ordinatis; ostiolum pororum saepissime fissura perpendicularis.

Descr. **C.** The annual ring boundary is completely blurred (Fig. 1), only here and there it can be guessed from the vessels becoming sparser and narrower. The vessels are circular or elliptic.

T. The horizontal ducts are distinct at a greater or lesser distance in the wide rays. Between the wide rays uni- and biseriate ones are rather frequent. In the walls of tracheids and tracheae the tiny bordered pits are loosely arranged in longitudinal rows; there are no spiral thickenings, but scalariform perforations in the vessels. The number of the bars of the scalariform perforation is 15–20 which, to a certain respect, is a platan character. The members of the narrower tracheae are generally short. The ray is more homogeneous. There are no angular calcium oxalate crystals in the ray cells.

This fossil by and large exhibits a great similarity to the *Icacinoxylon*s discussed so far, but it may be a *Platanoxylon* as well. Also milk ducts occur in the fossil, which is a characteristic feature of some genera of the *Icacinaceae*.

We have already discussed several *Icacinoxylon* species that exhibited some similarity to this fossil which, however, differs from all previous ones by its having milk ducts. Therefore, we propose to separate this fossil under the name *Icacinoxylon laticiferum* n. sp.

Note: Rákosi (1960) discusses one of the fossils of Dorog under the name *Dryoxylon* sp., founding its description on the structure of 12 slides. The author had the opportunity to survey these slides and to prepare new photos of them. The examinations demonstrated without any doubt that we have to deal with two species. Although the broad rays fairly agree in both types, their finer structures substantially differ. In one type the broad rays run at a distance of 8–10–12 tracheae, and there are dense vessels in the ground substance. In the other type the vessels between the broad rays are arranged much more loosely, and there is also a difference in the shape of the cross sections. These forms mainly differ in that in the rays of one of the two vertical and longitudinal ducts are running which are filled with epithelial cells. The cross-section structure of the ducts is clearly illustrated by Fig. 8 in Plate XLV. Thus, this is such a type with broad rays where ducts are running also in the rays.

L. Dorog; **A.** Oligocene.

Icacinoxylon crystallophorum n. sp.

Plates XLVI, Figs 1–4; XLVII, Figs 5–8.

Diagnosis: Limites stratorum concentricorum obsoleti, tracheae inter radios medullares latos in texto fundamentali e fibris ligni efformato laxe dispositae, in sectione transversali plus-minus angulares. Radii medullares latitudine 10–14-cellulares. Textum fundamentale e fibris ligni compositum, in texto fundamentali cellulae parenchymae longitudinalis crystallos calcii oxalati continentes conspicue multae. Radii medullares heterogenei, tracheidae spiraliter incrassatae, perforatio scalaris, usque ad 10–50 gradibus scalarum.

Descr. This species differs from the previous one in several respects. In **C.** the vessels are more angular. In **T.** no ducts are visible. The rays are wide, and there are hardly any uni- or biseriate ones among them. The parenchyma cells contain calcium oxalate crystals. The bordered pits' number is very low in the tangential walls of the tracheids. In the tracheae scalariform perforation and also spiral thickenings occur. The number of the bars which are uniformly dense is 40–50 in the perforations. The single members of the vessels are rather long; in this respect this fossil definitely differs from the previous species. The rays are of a rather heterogeneous structure. In their interior there are many calcium oxalate crystals.

Also this fossil is an *Icacinoxylon* by all probability. Since in the parenchyma and ray cells there are a great many calcium oxalate crystals, we name it *Icacinoxylon crystallophorum* n. sp.

Note: From the environments of Nagybátony two fossils were examined. Both of them were of a dark grey, almost black colour, owing probably to burning or carbonization by volcanic ashes and subsequent silicification. They were compact enough and suitable slides could be prepared. The external aspects of these two fossils cannot be distinguished: they probably originate from the same stem.

L. Dorog; **A.** Oligocene.

Icacinoxylon shilkinae n. sp.

Plate XLVIII, Figs 1–9.

Diagnosis: Lignum disperse porosum, limites stratorum concentricorum obsoleti, tracheae in genere solitariae, textum fundamentale e fibris ligni constructum. Radii medullares 1–3-stratosi, forte etiam accumulati, structura heterogenei. Tracheae perforatione scalari tantum, gradibus usque ad 35, spiraliter structae, poris parvis areolatis, oblique seriatis.

Note: As for its anatomical features and mainly its broad rays, the fossil can be regarded as *Platanus, Magnolia, Liriodendron* but mainly *Dryoxylon* or *Icacinoxylon*. In *Platanus* and *Icacinaceae* the rays are in general very broad, sometimes even 20 cells wide, while in the fossil described they are at most 6–8 cells wide and even thus appear to be aggregated. In this respect the fossil allows to infer *Icacinoxylon* or *Dryoxylon*.

From *Platanus, Magnolia* and *Liriodendron* it differs by its vessels containing only scalariform perforations (in platans and magnolias not only scalariform but also simple perforations occur). The number of the bars in its vessels is 30–35 and they are often rather dense, whereas in platans and magnolias they are only 10–15 and rather sparse. Further, in the platans there are no spiral thickenings, the ray structure is homogeneous, and no aggregate rays occur.

The finer details of the fossil are mainly suggestive of *Icacinaceae*. Some genera of this family have aggregate rays and spiral thickening, and only scalariform perforations in the vessels. We think the silicified wood of Pomáz is some kind of *Icacinoxylon*.

The cross-section structure of *Plataninium* sp. studied by Sellmeier agrees with that of the fossil examined, save the tangential and radial structures which, as Sellmeier remarks, contain "neben einfacher Durchbrechung auch leiterförmige Perforationen". In our opinion it is not sure that it is a *Plataninium* either.

Shilkina (1958) described several new *Icacinaceae* species, but the fossil examined differs from these. In her honour I distinguish the fossil of Pomáz as *Icacinoxylon shilkinae*.

L. Pomáz (in the quarry SW of the village); **A.** Helvetian.

Icacinoxylon platanoides n. sp.

Plate XLIX, Figs 1–9.

Diagnosis: Lignum disperse porosum, sine limitibus stratorum concentricorum conspicuis, texto fundamentali e tracheidis fibrosis constitute, tracheis solitariis, vel geminis. Radii medullares longe fusoidei, in latitudine 10–12-cellulares, et in genere in altitudine 3–5 cellularum 1-stratose abolescentes, structura heterogenei. Tracheidae perforatione scalari, gradibus 15–20(–30). Tracheae spiraliter structae thyllis multis, poris areolatis parvis, oppositis alternatisve.

Descr. **C.** The broad rays running parallel are conspicuous (Fig. 1). In a diffuse porous wood the annual ring boundaries are hardly perceptible. Where they can be observed, the annual ring borders are somewhat concave (Fig. 2). The vessels are single, but here and there fit so closely together that the ground substance almost completely disappears. At other places paired pores or multiples of threes or fours can be seen. The cross sections of the vessels are circles or radially somewhat elongated ellipses, polygons. They are uniformly spacious and do not differ from each other, not even on the annual ring boundary. The ground substance is somewhat disorganized, consequently the elements cannot be easily distinguished. It could be established, however, that the ground substance was xylem fibre.

T. The high and comparatively thin spindle-shaped rays are conspicuous. The widths of the rays range from 16 to 20 cells, so far the wood agrees with *Platanus* (Figs 4 and 5). There is, however, a difference in that the upper and lower ends of the long rays of the fossil are tapering to uniseriate over a long sector. These marginal cells are 1–1·5 times higher than the interior ones, i.e. the rays are of heterogeneous structure, in contrast to *Platanus* (Fig. 9). The cross sections of the interior ray cells are circles, penta- or hexagons. In some of them a dark content remained (Fig. 5). The vessels or fibre tracheids are arranged beside the rays (Fig. 6). The broad vessels have only scalariform perforation as seen in the upper part of Fig. 8. The number of the bars is 10–15, sometimes even 30. In the tracheid walls the simple pits are sometimes arranged parallel, i.e. opposed to each other, which is also a *Platanus* character (Fig. 8). In the vessels there are many tyloses which in some sectors are in contact with each other (Fig. 6). The dense spiral bares running in the walls of almost all tracheae (Fig. 8) are often interrupted, owing to the high degree of disorganization; but this is no more *Platanus* structure.

The interior cells of the rays are elongated rectangles while the exterior ones are short procumbent or upright oblongs or square shaped (Fig. 9). Their walls are thick, and dense simple pitting is found in them.

Note: By its anatomical features the fossil can be considered as some kind of *Icacinoxylon*, though different from those discussed so far, because its rays have uniseriate endings (Fig. 6) and are much higher and much narrower than those of the previous species. Since many traits of the fossil agree with the platans, though its main features rather correspond to *Icacinaceae*, we designate it as *Icacinoxylon platanoides*.

L. Zirc (the SW slope of Kakashegy); **A.** Helvetian.

Icacinoxylon sylvaticum (Tuzson) Greguss n. comb.

Plates L, Figs 1–9; LI, Figs 10–18.

Note: This fossil form was described by Tuzson (1906) under the name *Magnolites silvaticum* and by Greguss (1954) as *Dryoxylon silvaticum.*

We propose to designate the silicified wood instead of *Magnolites sylvaticum* under the name *Icacinoxylon sylvaticum* n. comb.

L. Ipolytarnóc; **A.** Burdigalian.

Icacinoxylon sp.? (No. 1) seu *Platanoxylon* sp.

Plate LII, Figs 1–4.

Note: Also this fossil, similar somewhat to the two previous ones, contains broad rays which, however, are only 6–8 cells wide and run generally at a distance of only 4–5 tracheids beside each other. The ground substance is xylem fibre, in which single vessels are loosely arranged. The fossil resembles *Icacinoxylon crystallophorum,* discussed above, inasmuch as its rays are nearly of the same width and of heterogeneous structure. In the ray cells there are frequent calcium oxalate crystals mainly arranged in horizontal rows. Neither the rays nor the vessels exhibit a finer structure, owing to the high degree of disorganization; so we have to content ourselves by naming the fossil *Icacinoxylon,* neither leaving *Platanaceae* out of consideration.

L. Dorog; **A.** Oligocene.

Icacinoxylon sp.? (No. 2) seu *Platanoxylon* sp.

Plate LIII, Figs 1–9.

Note: On the basis of the anatomical features we propose to range also the fossil of Bajna to *Icacinaceae*. Its structure presents some similarity to, though no complete identity with, *Icacinoxylon crystallophorum*. Therefore we determine it as *Icacinoxylon* sp.? (No. 2) but at the same time we may give a thought to *Platanaceae*.

L. Bajna, Köveshegy; **A.** Oligocene (Pleistocene layer).

Icacinoxylon sp.? (No. 3) seu *Platanoxylon* sp.

Plate LIV, Figs 1–9.

Note: Since we did not succeed in establishing any specific properties, we designate it as *Icacinoxylon* sp. with the remark that the width of the rays and their arrangement definitely distinguish this silicified stem from the *Icacinoxylon* species discussed so far.

L. Cserháthaláp (Tornyoshegy, point No. 311); **A.** Helvetian.

Icacinoxylon sp.? (No. 4) seu *Platanoxylon* sp.

Plate LV, Figs 1–9.

Note: The anatomical features show a great similarity to the *Icacinaceae* species discussed above. Its most characteristic features are that the 16–18 cell wide rays run at a distance of 3–6 vessels, thinner rays occur only rarely, in its scalariform perforations the number of the bars are as high as 35, and ducts of considerable extent run in the xylem both in the horizontal and vertical directions. All these properties rule out that the fossil examined may be some kind of platan or magnolia.

L. Várpalota, Bántapuszta; **A.** Lower Helvetian.

Icacinoxylon sp.? (No. 5) seu *Platanoxylon* sp.

Plate LVI, Figs 1–6.

Descr. **C.** In spite of the high degree of transparency and disorganization, it was possible to distinguish broader and narrower, rather compact parallel bands (Figs 1 and 2), from which some kind of *Platanoxylon* or *Icacinoxylon* may be inferred. Between the broad rays the vessels are irregular polygons, due probably to compression. The ground substance, which is hardly discernible, is perhaps xylem fibre. No vertical ducts could be established either in the ground substance or in the rays.

T. (Figs 4 and 5). Only the spindle shape of the very high and narrow rays could be established. The rays are 6–8–20 cells wide; in this respect the fossil hardly differs from those determined so far as *Icacinoxylons*. No finer details could be established either in the ground substance or in the rays.

R. (Figs 3 and 6). Owing to the high degree of compression, no important details on the ray structure or the elements of the ground substance could be established, at most the presence of the scales could be guessed. Here and there 6–8 and even 10 scales were observed (Fig. 6) without any finer perforations. At some places the calcium oxalate crystals are arranged in longitudinal rows (Fig. 3) suggesting *Icacinoxylon crystallophorum* with which, however, no other details of the fossil can be identified.

Note: On the strength of the scarce anatomical features the fossil described is some *Icacinoxylon*.

L. Cinkota (Újtelep); **A.** Helvetian.

Icacinoxylon sp.? (No. 6) seu *Platanoxylon* sp.

Plate LVII, Figs 1–9.

Descr. **C.** Wide rays and the shape and structure of the vessels arranged between them could be established. The cross sections of the vessels are irregular polygons, some of them slightly elongated in a radial, others in a tangential direction. Their diameter is ranging from 35 to 50 μ. The dense rays are 1–20 cells wide; there is hardly any ground substance between them (Fig. 3). Thus the fossil definitely differs from the *Icacinoxylons* discussed so far. In the broad rays there are longitudinal ducts which permit to infer *Icacinaceae*, though we have to give a thought also to *Platanaceae*.

T. The broad rays are conspicuous and contain sometimes several ducts (Figs 4 and 5). In this respect they are perfectly similar to the *Icacinoxylons* discussed so far.

R. The same properties can be observed as on the above specimens. The heterogeneous ray structure is definite, which also suggests *Icacinaceae*. In the ray cells, apart from the dark content, calcium oxalate crystals are frequent. On the spots corresponding to the longitudinal tracheae here and there the pieces of a scalariform perforation can be observed, this feature corroborates our opinion that the fossil might be an *Icacinoxylon*.

L. Pécsszabolcs (NW of the sports ground); **A.** Helvetian.

Icacinoxylon sp.? (No. 7) seu *Platanoxylon* sp.

Plate LVIII, Figs 1–7.

Descr. **C.** highly resembles the structure of the piece of stem that came to light from the Helvetian stage of Nagybátony (Fig. 1). The vessels in the annual rings are single and only in the rarest cases associate to pairs. In a diffuse-porous wood the annual ring boundary is hardly noticeable, the rays, 10–20 cells wide, run almost parallel, among them here and there thinner, 2–3 cell wide rays are found (Figs 2 and 3).

T. Xylem fibres and tracheids proceed between the broad rays (Figs 4 and 5). The members of the vessels communicate by scalariform perforation (Fig. 7).

R. The number of bars is 18–20, so there is a similarity to the fossil of Nagybátony.

Scalariform perforation and spiral thickening lend great probability to the view that the fossil is *Icacinoxylon*.

L. Mór (Árki-puszta); **A.** Helvetian.

Icacinoxylon sp.? (Nos 8–16) seu *Platanoxylon* sp.

Plates LVIII, Figs 8 and 9; LIX, Figs 1–9; LX, Figs 1–9.

The intervals of the broad rays are filled with wide bands of vessels, which are mostly single or 2–3 of them fit closely together.

Descr. **T.** The rays are 8–10–12–20 cells wide and 70–120 cells high. Ducts can be observed in the broad rays only in the rarest cases; these may be due to disorganization. Therefore we range the fossil of Bodajk only with reservation to *Icacinaceae*.

R. The tracheid walls show traces of spiral thickenings and scalariform perforations, which are indicative rather of *Icacinaceae* than of *Platanaceae*.

The fossil of Iszkaszentgyörgy agrees with the fossil of Bodajk, as regards cross section, tangential and radial structure. In the walls of the vessels, spiral thickening and scalariform perforations are rather frequent. The number of bars can be as high as 30–35.

Also the interior structure of the fossil of Homokbödöge is particularly suggestive of that of the fossil of Bodajk. **C.** and **T.** almost completely agree with each other. It is interesting to note that on **R.** the ray cells are abounding in calcium oxalate crystals.

C. of the fossil of Pénzeskút is somewhat different, since the vessels between its broad rays are much smaller than they are in the three fossils discussed above. On **T.** the structure of the broad rays is seen only indistinctly, while on **R.** the spiral thickening of the vessels and the scalariform perforation can be definitely established.

Though it is possible that some of the stems examined, e.g. the records of Rátka and Megyaszó, are platan species.

L. (No. 8) Megyaszó, (No. 9) Budapest (Mátyásföld), (No. 10) Hárságy, (No. 11) Bodajk, (No. 12) Iszkaszentgyörgy, (No. 13) Homokbödöge, (No. 14) Solymár, (No. 15) Pénzeskút, (No. 16) Rátka;

A. (Nos 8 and 16) Sarmatian, (Nos 9, 10, 12, 13, 15) Helvetian, (No. 11) Lower Helvetian, (No. 14) Oligocene.

Icacinoxylon sp.? (No. 17) seu *Platanoxylon* sp.

Plates LVI, Figs 7–9; LXI, Figs 1–9.

Note: As regards anatomical features, the fossil may belong to *Icacinaceae* or to another family with broad rays. Sellmeier described a *Platanoxylon*, in which the width and height and direction of the rays, the location of the vessels, the arched curvature of the annual ring boundary, the perforation of the vessels all agree with the corresponding details of the fossil of Nagybátony. Also spiral thickenings occur in the vessels of both stems. Such are not found in platans.

The record of Nagybátony is perhaps most suggestive of the fossil described by the Dutch Slyper. In this species a spiral thickening similar to that of the specimen of Nagybátony is seen.

The whole structure of the fossil described is still more suggestive of *Icacinaceae*, therefore we name it rather as an *Icacinoxylon* sp.

L. Nagybátony; **A.** Burdigalian.

Icacinoxylon sp.? (No. 18) seu *Platanoxylon* sp.

Plate LXII, Figs 1–8.

Note: Its ray structure is heterogeneous, it has spiral thickenings, and all its perforations are scalariform, so we cannot go far wrong when qualifying this specimen also as some *Icacinoxylon* sp.

L. Nógrád, Élesmező; **A.** Helvetian.

MONOCHLAMYDEAE

18. BETULACEAE

Alnus sp.

Plate LXIII, Figs 1–7.

We succeeded only in preparing some wood splitters from the conglomerate and we made sections and photos of these. From the pitting of the vessel in Fig. 3, and from the perforations seen at some places at the ends of the vessels we may infer some kind of *Alnus*. This assumption is supported by the fact that Kedves found a huge amount of *Alnus* pollen in the conglomerate. Since neither **C.** nor **T.** are known, we abstained from providing the fossil with a specific name.

L. Emőd; **A.** Pleistocene.

Carpinoxylon hungaricum Greguss

Plate LXIV, Figs 1–4.

Note: This fossil from Füzérkomlós was recorded by Greguss (1943b).

All five pieces of stem or branch may have originated from the same wood, because they have identical structures. Since the fossil does not perfectly agree either with *Carpinus betulus* or with *Carpinus orientalis*, and not even with any recent *Carpinus* species, it may be a representative of an extinct species.

L. Füzérkomlós; **A.** Sarmatian.

Carpinoxylon sp.

Plate LXV, Figs 1–6.

Descr. **C.** Between the uni- and biseriate rays tracheae of about the same size are situated partly solitarily, partly in smaller or larger groups, possibly in a radial arrangement. However precious, hardly more than the wood presents a uniform structure can be established; there are no conspicuous annual ring boundaries, which permits us to infer an equable climate.

T. (Fig. 3) Ampler information as to the interior structure of the wood is supplied. The rays are in general uniseriate, at some places they seem to be arranged more densely, suggesting aggregate rays. Even so this structure does not supply enough evidence for a safe determination. Figure 4 presents a 100-fold, while Figs 5 and 6 a 300-fold magnification of the radial structure. These radial slides indicate that the ray cells are generally of the same height. As to the finer structure, the photos of higher magnification from the radial slide will convey some information. In Figs 5 and 6 it clearly appears that not only dense bordered pits are aligned or concentrated in the vessel walls closely to each other but there are also thin spiral thickenings in the vessels. The spirals subtend an acute angle to the longitudinal axis, which is suggestive of *Carpinus*.

The simple perforation of one of the tracheids clearly appears in Fig. 5. This wood structure is highly suggestive of the tracheal perforations of recent *Carpinus*, but definitely differs from those found in Central Europe, mainly because of its cross slide structure. It may better agree with some Far-Eastern or American *Carpinus* species.

According to the personal communication of Rásky, also leaf imprints of *Carpinus grandis* Ung. were found among the fossils of Ipolytarnóc.

In lack of comparative material, it was not possible to determine the piece of stem No. 2/b from Kubinyi's site, but since it is highly reminiscent of the structure of *Carpinus,* I propose to list it by the name *Carpinoxylon* sp.

L. Ipolytarnóc; **A.** Burdigalian (Lower Helvetian).

Quercoxylon suberoides n. sp.

Plate LXVI, Figs 1–3, 6, 6a and 9.

Diagnosis: Lignum annulariter porosum, ineunte zonae prioris tracheae latae plerumque uniseriatae, strata concentrica angusta, iuxta radios medullares latiores in radiis medullaribus unistratosis crystalla calcii oxalati, pori cellularum parenchymae radiorum medullarium tracheas latas tangentium reticulate dispositi, sicut in Quercus suber L. recenti.

Descr. **C.** It can be established that it is a ring-porous wood. At the beginning of the spring wood there are wide tracheae arranged densely side by side, while an arrangement in two rows seldom occurs. The radial diameters of the spring vessels are 370–400 μ, at some places they show a gradual transition towards the annual ring boundary. The cross sections of the vessels are circles, ellipses, or rounded polygons. The ground substance is thick-walled xylem fibre interrupted in the tangential direction by parenchyma rows. Single parenchyma cells, however, are also rather frequent in the ground substance. This structure presents a *Quercus* character.

T. Beside the quite broad rays, uniseriate ones are seen. In the latter there are calcium oxalate crystals, which is also characteristic of *Quercus.*

R. At the contact of the ray cells with broad vessels, the shape, size and arrangement of the pits are highly suggestive of the ray pitting of *Quercus suber.*

Note: This is also verified by a comparison of Fig. 6 with the radial photo of *Quercus suber* (Fig. 6a), so the fossil may have originated from a species similar to the recent *Quercus suber.*

L. Sály (Medve-árok); **A.** Sarmatian.

The original material is in the Hungarian National Museum under No. 119.

Quercoxylon sp. (No. 1)

Plate LXVII, Figs 1–3.

Descr. **C.** shows a ring-porous wood; in the spring wood the vessels of wide lumina are generally arranged in 1–2–(3) rows. The radial diameters of the vessels with wide lumina are 350–400 μ, their interior is filled with thin-walled tyloses. The wide vessels of the spring wood are not gradually narrowing, but the trachea and tracheids of the much narrower lumina course in narrower or wider bands towards the annual ring boundary. Next to the vessels with wide lumina there follow vessels with diameters of hardly 40–50 μ, that is they are almost one-tenth of the vessels with wide lumina of the spring wood. The intervals of the tracheids and vessels are filled with thick-walled xylem fibres; between these the uniseriate narrow rays run, while the broad rays are scarce, their width is 25–30 cells.

T. Only uniseriate rays are found between the broad rays, the heights of these are 1–20 cells.

R. Owing to a high degree of disorganization, no finer details, and mainly no pits at the cross fields of the broad vessels and rays could be established.

Note: The silicified wood is beyond doubt a *Quercus* species. In lack of further details we mark it simply as *Quercoxylon* sp. (No. 1).

L. Monosbél (Szőllőmege dűlő); **A.** Helvetian.

The original material is in the Hungarian National Museum under No. 1014.

Quercus sp. (No. 2)

Plate LXVII, Figs 4–6.

Note: Cross section, tangential and radial structures suggest that also this silicified wood must have been some *Quercus*. Its structure distinctly differs from that of the fossil of Sály, but its *Quercus* character is definite. Since the pitting of the rays could not be established, we mark the fossil as *Quercus* sp. (No. 2) though its different cross section would admit of a new name; however, we mention it only as a record.

L. Cegléd; **A.** Pleistocene.

The original material is in the Hungarian National Museum under No. 61.919.1.

Quercoxylon sp. (No. 3)

Plate LXVI, Figs 4, 5, 7 and 8.

Note: The fossil found in the gravel-pit of Pestszentlőrinc is by and large similar to the silicified piece of Cegléd, though cannot be identified with it. Also this is a ring-porous wood, but in the spring wood the vessels are arranged much more loosely and the spring vessels of wide lumina are gradually narrowing towards the annual ring boundary. The radial diameter of the vessels of wide lumina is 350–400 μ. The diameter of the next row of vessels is 140–150 μ, then 65–70 μ, while immediately next to the annual ring boundary 30–40 μ.

Thus in **C.** the distribution and the diameters of the vessels of this *Quercus* species somewhat differ from those in the previous one. The same refers to **T.** On **R.** owing to disorganization, the finer structure and pitting of the rays cannot be exactly established; this is why we mark the fossil *Quercoxylon* sp. (No. 3), mentioning it only as a record.

L. Pestszentlőrinc; **A.** Pannonian.

The original material is in the Hungarian National Museum under No. 61.920.1.

Quercoxylon cf. *böckhianum* Müller-Stoll and Mädel

Plate LXVIII, Figs 1–4 (No. 1); Figs 5–7 (No. 2); Fig. 8 (No. 3).

Note: The slides prepared from the fossil of Kemenes verified the genus *Quercus*. In a ring-porous wood the vessels with wide lumina lie at the onset of the spring wood in one or two layers, followed in the late wood by flamboyant bands of vessels with narrow lumina, which are widest at the annual ring boundary and narrowest when nearest to the vessels with wide lumina. In this structure it most resembles the fossil *Quercoxylon* sp. (No. 1).

The *Quercus* character is most conspicuous in **T.** Along with the rays 18–20 cells wide there course uniseriate rays which are in general 8–10 cells high.

R. supports the *Quercus* character. The vessels with wide lumina are filled with abundant tyloses, while the cross fields contain elliptic or curved simple pits. Since the cross fields of the cross sections and the pittings by and large agree with *Quercoxylon böckhianum* described by Müller-Stoll and Mädel, we determined the Pannonian fossil of Kemenes as such.

The same applies to the Oligocene specimen collected by Rákosi at Dorog and to the Oligocene fossil of Tata. In the Plate, the fossil of Dorog is marked as *Quercoxylon* sp. (No. 3) and that of Tata as *Quercoxylon* sp. (No. 2). It could not be stated quite decisively that they belong to *Q. böckhianum*, but since they are most similar to this species, we may regard them as such with some degree of certainty.

L. (No. 1) Kemenesmagasi, (No. 2) Tata, (No. 3) Dorog;

A. (No. 1) Pannonian, (Nos 2 and 3) Oligocene.

Besides the above species, Andreánszky describes *Quercoxylon avasense*.

The drawings and description of the fossil of Megyaszó determined by Félix as *Quercinium böckhianum* certainly verify *Quercus* which, however, definitely differs from the *Quercus* of the Oligocene found at Dorog. It is a characteristic feature of *Quercinium böckhianum* that the zone of the vessels funnel-like widens from the spring vessels of wide lumina towards the autumn wood where it directly joins the vessels of wide lumina of the spring wood in the next annual ring. This fossil has been recently revised by Müller-Stoll and Mädel and determined as *Quercoxylon böckhianum*.

Müller-Stoll and Mädel (1960) revised also the oaks from the Hungarian Pannonian layers elaborated by Félix (1887) and Unger, and provided them with new names. They applied, instead of the antiquated *Quercinium*, the generic name *Quercoxylon*, accepted today as correct. So the *Quercinium sabulosum* Unger of Ajka became *Quercoxylon densum* Müller-Stoll and Mädel, the *Quercinium böckhianum* of Megyaszó *Quercoxylon böckhianum* (Félix) Müller-Stoll and Mädel, the *Quercinium viticulosum* of Nagyvölgy *Quercoxylon viticulosum* (Ung.) Müller-Stoll and Mädel. Unfortunately, not all of the photos published are convincing, but on the grounds of the drawings and the detailed descriptions in the text we regard the original determinations as correct. Müller-Stoll and Mädel also state that it was not possible, for deficiency of data, to compare the species *Quercoxylon avasense* described by Andreánszky with the other oak fossils and this is also the opinion of the author.

Éva Kovács (1955) determined several *Quercus* stems and regards the fossil of Kissvábhegy, ranged erroneously into Upper Eocene, as *Quercus cerris*. The fossil originates, however, according to Vadász, not from Eocene limestone but from the rest of Oligocene of possibly Helvetian erosion.

The stem originating from Romhánypuszta, from the Lower Miocene is related by the same author to *Quercus robur*. According to Andreánszky (1959), the stem of Kemenesmagasi from the Middle Miocene is suggestive of *Quercus pubescens*. The fossil found near Buják is brought in connection with *Quercus ilex*. The *Quercoxylon avasense* of Andreánszky presents greatest similarity to *Quercus frainetto*, while the Pannonian fossil of Megyaszó again to *Quercus cerris*.

20. JUGLANDACEAE

Pterocaryoxylon pannonicum Müller-Stoll and Mädel

Plate LXIX, Figs 1–9.

Descr. **C.** A diffuse-porous wood shows rather blurred annual ring boundaries following each other at distances of about 5–6 vessels. The radial diameter of the vessels is 120–150 μ, their width 110–120 μ. They are single, paired or multiples with 3–5 members. In the multiples the vessel towards the early wood is the largest, towards the late wood the smallest, but sometimes between two large vessels a much smaller one may be located, and so the multiples also may be composed of vessels of different size. The apotracheal parenchyma bands are generally uniseriate and course in a somewhat undulating row, but fairly parallel to the annual ring boundary. The ground substance is simple xylem fibre the cells of which are arranged in longitudinal rows. The rays are 1–2 cell layers wide.

T. The rays are in general uni- or biseriate, 2–25 cells high and of rather heterogeneous structure. A characteristic property of this silicified wood is that the longitudinal parenchyma cells are full of solitary calcium oxalate crystals. No finer structure of the xylem fibres could be established, owing to the high degree of carbonization.

R. The same refers to the radial structure where the pitting of the vessels could be established on one spot only. In the walls of the vessels the tiny bordered pits are alternating in oblique rows. The perforation is simple and generally narrower than are the lumina of the vessels. Where the ray cells and the longitudinal vessels meet there are many circular or elliptic pits in the rays (Fig. 9), which is also characteristic of *Juglandaceae*. The cross-section structure is suggestive of the

Eucaryoxylon crystallophorum, but since it is not a ring-porous but a diffuse-porous wood, it cannot be an *Eucaryoxylon* but a *Pterocaryoxylon.*

Note: The fossil by and large agrees with *Pterocaryoxylon pannonicum* described by Müller-Stoll and Mädel (1960) and is regarded by us as identical with it.

L. Parádfürdő (Ördöggátak); **A.** Lower Helvetian.

Pterocaryoxylon cf. *pannonicum* Müller-Stoll and Mädel

Plate LXX, Figs 1–4.

Descr. **C.** shows a diffuse-porous wood, the annual ring boundary of which is hardly noticeable. The ground substance consisting of xylem fibres, the members of which follow each other in longitudinal rows, is interrupted here and there by apotracheal parenchyma. The vessels are solitary, paired or multiples with 3–4 members. This structure resembles the fossil of Piliny but for the distribution of the pores and the structure of the apotracheal parenchyma; still the *Juglandaceae* character is distinct. It is also supported by the tangential and radial structure of the rays.

T. The structure of the rays can be noticed only here and there, owing to the high degree of compression and burning. The rays are 6–8–10 cells high and uni- or biseriate. The calcium oxalate crystals characteristic of *Juglandaceae* can be distinctly recognized in the cells of the longitudinal parenchyma. However, no ray skeleton of definite structure could be established on the tangential side.

R. Essentially the same could be stated, we succeeded only in establishing a heterogeneous structure of rays at some spots. It is interesting to note that a duct of 350 μ diameter caused by gnawing of insect could be observed.

This fossil is nearest to the species *Pterocaryoxylon* cf. *pannonicum* without being identical, therefore we only conditionally range it here.

The cross-section structure also permits of *Cyclocarya.*

L. Nemti; **A.** Lower Helvetian.

The original material is in the Hungarian National Museum under No. 61. 939.1.

Pterocaryoxylon pilinyense n. sp.

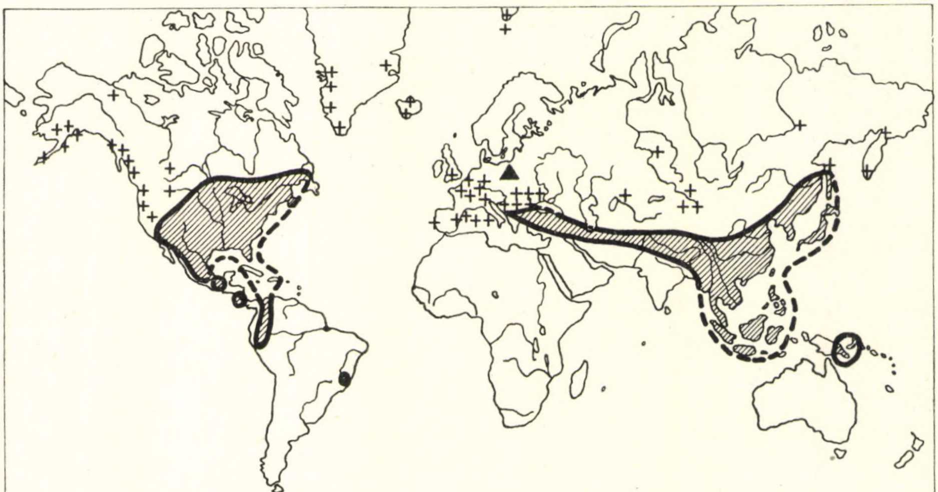
Plate LXXI, Figs 1–9.

Diagnosis: Lignum disperse porosum, tracheae in texto fundamentali solitariae, geminae, vel radios pororum breves efformantes, pariete crasso. Fasciae parenchymae apotrachealis 1–2-stratosae, tracheae parenchyma paratracheali circumdatae, radii medullares latitudine ex 1–3 stratis cellularum formati, radii, medullares 2-stratosi nonnunquam in partes 1-stratosos longe continuati. In cellulis parenchymae longitudinalis crystalla calcii oxalati solitaria; paries trachearum poris foveolatis parvis dense coopertus, in tracheis thyllae et perforatio simplex.

Descr. **C.** A diffuse-porous wood, with hardly perceptible annual ring boundary. In the ground substance the vessels are single, paired, or multiples with 3–4 members. In the three-membered pore rays the vessels towards the spring wood are larger than those towards the late wood. Their diameters are variable. The diameter of the single ones is 140–150 μ. The double wall is about 14–16 μ thick, the contacting wall courses nearly always parallel to the annual ring boundary. Sometimes 5–6 vessels follow in sequence with gradually diminishing diameters (Fig. 1).

The ground substance consists of xylem fibres arranged in radial rows and interrupted by uni- or biseriate parenchyma bands running in the tangential direction. In some of the parenchyma cells calcium oxalate crystals are found. Such cross-section structure permits first of all to infer *Juglandaceae*, particularly *Pterocarya* in which the vessels are generally single; short radial multiples only very seldom occur. The vessels are surrounded by paratracheal parenchyma. In the rays and parenchyma bands a dark content is found rather frequently.

T. The rays between the xylem fibres are uni- or biseriate, exceptionally triseriate, when the cells are alternating. Between these there are longitudinal parenchyma cells 70–80 μ long and 18–20 μ wide. No finer structure could be established, owing to the high degree of disorganization. The vessels are single or paired. They are filled with thin-walled tyloses. The perforation is simple, no scalariform perforation can be established. The surface of the vessels is densely covered with bordered pits, the borders of which are strongly compressed, deltoid or hexagonal.



Map 6. Recent distribution of the *Juglandaceae*. Cretaceous and Tertiary fossil sites (+). Tertiary sites in Hungary (triangle)

R. No finer structure of the rays can be established, save that they are definitely heterogeneous. The interior cells are horizontally elongated rectangles while the marginal ones are upright oblongs. Between the xylem fibres there are parenchyma cells, in some of which calcium oxalate crystal rows are found. Sometimes even 6 to 8 crystals follow each other, which is an important diagnostical feature.

Müller-Stoll and Mädel (1960) elaborated the Tertiary *Juglandaceae* woods of the Pannonian basin. According to the cross-section structures, it was easy to separate *Pterocarya*, *Juglans* and *Carya* which they ranged into three new genera: *Pterocaryoxylon*, *Caryojuglandoxylon* and *Eucaryoxylon*. They ranged to *Pterocaryoxylon* the *Pterocarya* and partly the *Juglans*, to *Caryojuglandoxylon* partly the *Juglans* and partly the *Carya*, whereas to *Eucaryoxylon* the *Carya* in the proper sense of the word.

In the fossil of Piliny the walls of the vessels are comparatively thick, the rays 1–2 cell layers wide. The diffuse-porous wood cannot be *Carya*.

Félix (1887) described from Megyaszó several stems of *Juglandaceae* which were recently revised by Müller-Stoll and Mädel (1960). As a result they determined the *Liquidambaroxylon speciosum* of Félix as *Pterocaryoxylon pannonicum*. The fossil examined here agrees by and large with this latter one. Its apotracheal parenchyma bands are similar. It differs, however, in that rays are spindle-shaped rather than sturdy, and also in the distribution of the rays. The genus *Juglans* cannot enter into consideration, since there is hardly any apotracheal wood parenchyma in it, while in the fossil it appears quite characteristically. Therefore the stem examined cannot be *Juglandoxylon*, but it cannot be *Carya* either, because in the longitudinal parenchyma cells the single calcium oxalate crystals are arranged in longitudinal rows and not separately as is characteristic of *Carya*. I name the fossil *Pterocaryoxylon pilinyense* as distinct from *Pterocaryoxylon pannonicum*.

L. Piliny; **A.** Helvetian.

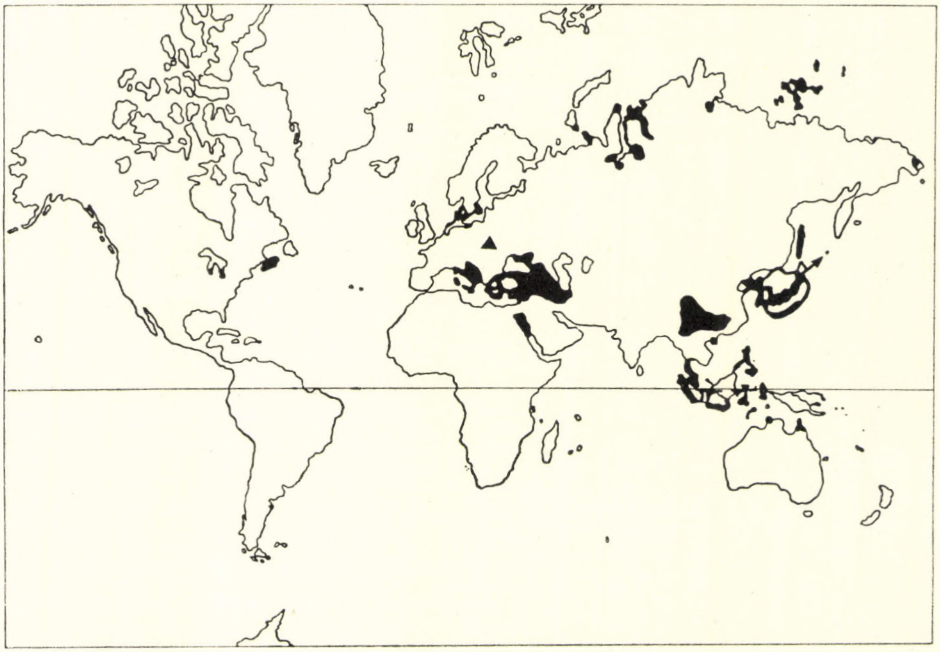
The original material is in the Hungarian National Museum under No. 206.

Eucaryoxylon budense n. sp.

Plate LXXII, Figs 1–9.

Diagnosis: Lignum magis annulariter porosum, in stratis concentricis solum tracheae nonnullae dispersae, solitariae, vel geminae. Radii medullares latitudine ex 1–2 stratis cellularum formati, parenchyma apotrachealis laminas latitudine ex 1–2 stratis cellularum formans, in texto fundamentali ex fibris ligni constituto idioblasti solitarii, et in iis crystallum solitarium calcii oxalati. Radii medullares latitudine ex 1–2 stratis cellularum constructi, altitudine ex 20–25 cellulis compositi, structura heterogenei.

Descr. **C.** shows a ring-porous wood, since the vessels with wide lumina are arranged on the annual ring boundary in annular form. They are single, paired,



Map 7. Recent distribution of the genus *Pterocarya* (after Krüssmann). Helvetian sites in Hungary (triangle)

or quite short multiples. The rays are uni- or biseriate. Parallel to the annual ring boundary, the apotracheal parenchyma cells are generally arranged in the ground substance in one-row plates. Besides the rays, very often crystal cells with wider lumina are found; these contain single crystals. This cross-section structure is highly suggestive of the recent *Carya alba*. Figure 2 refers to the recent *Carya alba* while Fig. 1 to the fossil discussed. The similarity of the two is conspicuous. The apotracheal parenchyma plates are uni- or biseriate both in recent *Carya* and in the fossil described (Figs 2–4).

T. The rays are 1–25 cells high and of heterogeneous structure. The terminal cells are much higher than the interior ones; the cross sections of the latter are generally hexagonal and more or less alternating. Three cell layer wide rays rarely occur. On the longitudinal parenchyma cells the calcium oxalate crystals are generally single and only in the rarest cases can 2–3 crystals be found beside each other. The single crystals are characteristic of *Carya*, distinguished exactly by this feature from *Juglans* and *Pterocarya*.

The same can be readily established in Figs 4, 7 and 8.

Note: On the grounds of the anatomical features this fossil is to all probability some species of *Carya*. The *Carya* differ both from *Juglans* and *Pterocarya* mainly by the ray structure, the annular arrangement of the vessels, and the presence of the single calcium oxalate crystals.

Since these features can be found also in the fossil discussed, we regard it as a *Caryoxylon* and range it on the grounds of the determination of Müller-Stoll and Mädel into the genus *Eucaryoxylon* distinguishing it more exactly by the name *E. budense* n. sp.

L. Budapest (Mátyásföld); **A.** Lower Helvetian.

Eucaryoxylon crystallophorum Müller-Stoll and Mädel

Plate LXXIII, Figs 1–4.

(*Pterocarya* cf. *massalongi* Greguss)

Descr. **C.** The piece examined is to all probability some kind of *Juglandaceae* which is mainly verified by the cross-section structure. The arrangement of the multiples of 2–3, less frequently 4 pores, is similar in the recent species of the genera *Juglans*, *Pterocarya* and *Carya* and in the fossil represented. In all of them a conspicuous character is the terminal parenchyma chain running parallel to the annual ring boundary and arranged in rows. Since the wood structures of *Juglans*, *Carya* and *Pterocarya* are very similar to each other, it is not impossible that the branch in question derives from some *Juglans* or *Carya*. The *Pterocarya* character and analogy are conspicuously shown by the cross-section structure. Our fossil almost completely agrees in this respect with *Pterocarya stenoptera* living today.

T. Some difference is found, however. While in *Pterocarya stenoptera* the rays are uni- and biseriate, and triseriate rays can be hardly found among them, the width of the rays on the silicified wood examined is 2–3 seriate and can be exceptionally even 4 seriate, like in *Carya*.

Neither can the silicified wood be completely identified with *Pterocarya fraxinifolia* living in the Caucasus, because the rays of this are not thicker than biseriate either.

The cross section shows a great similarity to the structure of the species *Juglandinium schenki* described by Félix (1884). Unfortunately, no more is known of this wood than that it was found in Hungary and came to light from Tertiary layers. The specimen examined is at present in the Museum of Mineralogy in Leipzig. By a comparison with the recent *Juglans* and *Pterocarya* we think the fossil in question must have originated from the stem of some *Pterocarya*. Müller-Stoll and Mädel (1960) have examined a larger piece of the same stem and determined it as *Eucaryoxylon crystallophorum*.

L. Füzérkomlós; **A.** Sarmatian.

Pterocaryoxylon sp.

Note: Andreánszky (1959) mentions a *Pterocaryoxylon* also from Mikófalva.

Tuzson (1906) referred to a fossil from Városlőd from Mediterranean gravel layers, but did not determine it in lack of sufficient anatomical features. He merely stated that the annual ring boundaries were blurred, the rays 1–3 seriate, the vessels single, or forming shorter or longer pore rays. He made the same statement on the fossil of Pét.

According to our examinations, the fossils of Mikófalva and Városlőd may have been some kind of *Pterocarya*, since in both of them the rays are bi- or tri-seriate, the vessels are single, or paired pores in the annual rings, while the short multiples of 3 or 5 members follow one another at wide distances. This assumption is supported by the radial structure of the fossil.

It should be noted that Andreánszky (1959) determined the fossil collected near Selyp as *Pterocaryoxylon* with the reservation that "the deficient anatomical descriptions do not prove the *Pterocarya* origin of the wood opal of Selyp".

21. SALICACEAE

Populoxylon sp. (cf. *Populus alba*)

Plate LXXIV, Figs 1–9.

Descr. **C.** The wood showed a structure of diffuse pores; the annual ring boundaries were hardly noticeable. In the annual ring the vessels are generally grouped into pairs, sometimes also in multiples of 3 or even 4 members. Single vessels are rare. The rays are uniseriate and running at a distance of one vessel, radially. The ground substance consists of xylem fibres. This structure reminds us of that of the genus *Populus*.

T. All rays are uniseriate, biseriate details could be observed very rarely. Their height is in general 8–10 cells. The upper and lower cells being somewhat higher, a heterogeneous structure of the rays can be guessed. Besides the rays, xylem fibres were concealed; no wood parenchyma could be observed. The uniseriate arrangement of the rays also permits to infer *Populus*.

R. In the walls of the vessels bordered pits are alternating close to each other, the perforation is always simple. This pitting of the tracheae also points to *Populus*. The aperture of the bordered pits is a circle or procumbent short ellipse or slit.

The most characteristic feature of the wood has been observed on the ray cells which are elongated parenchyma cells. The sometimes 2–3 rows of marginal cells situated above each other show characteristically the simple pitting of the ray cells of *Populus*. In most cross fields the simple circular pits are arranged in two and only very exceptionally in three rows.

Note: The anatomy of this fossil certainly suggests some kind of *Populus*, that is *Populoxylon*. This is verified by the structure of diffuse pores, the uniform xylem fibre substance, the uniseriate, 10–15 cell high rays, the alternating contact of the bordered pits in the tracheae, the heterogeneous ray structure and the arrangement of the bi- or triseriate, comparatively large simple pits in the marginal cells.

Andreánszky (1955) demonstrated several *Populus* species from Mikófalva as imprints. These, however, probably did not belong to so many species, because the separation was carried out merely by the variation of the leaf shape. It is possible that the silicified wood can be identified with one of these. The fossil is very much suggestive of the structure of *Populus alba.*

L. Mikófalva, **A.** Sarmatian.

Populoxylon sp. (cf. *Populus tremula* L.)

Plate LXXV, Figs 1–5.

Descr. **C.** suggests the family *Salicaceae*, first of all of the genus *Populus*.

The wood appears to be diffuse-porous, but at the beginning of the spring wood the vessels are arranged beside each other solitarily, in pairs or in multiples by threes or fours. Here their lumen is somewhat larger than in the late wood. The intervals of the vessels are filled with xylem fibres, between which uniseriate rays are seen.

T. The rays are uniseriate and 1–20–25 cells high (Fig. 3). In the tracheid walls the bordered pits closely fit together in oblique rows, their shape is trapezoid or deltoid. The aperture is a short slit which does not reach the border (Fig. 4).

R. The heterogeneous structure of the rays is conspicuous. The ray cells are comparatively low, the simple large pits in them are generally aligned beside each other in two rows, which is characteristic of the genus *Populus*.

Note: The fossil is certainly some kind of *Populus*. Its interior structure is most similar, of recent forms, to *Populus tremula* L.

Andreánszky (1955) publishes from Mikófalva a *Populoxylon* sp. (cf. *Populus tremula* L.) remain, the determination of which is undoubtedly correct.

The determination of Horváth (1954) from Megyaszó is correct. On the grounds of description and photograph it is *Populoxylon.*

L. Mikófalva; **A.** Sarmatian.

The material examined is in the Hungarian National Museum under No. 61.925.1.

22. ULMACEAE

Zelkovoxylon yatsenko-khmelevskyi n. sp.

Plate LXXVI, Figs 1–9.

Diagnosis: Lignum annulariter porosum, tracheis magnis 350–400 μ latis, in limite stratorum concentricorum 1- vel 2-seriatis, texto fundamentali e parenchyma vasicentrico et e fibris ligni constructo circumdatis, in zona posteriore tracheis minoribus. Radii medullares altitudine ex 1–40 cellulis, latitudine ex 3–4 cellulis constructi, structura homogenei. Parenchyma haud rara, crystallis calcii oxalati rhomboedricis. Membra trachearum dolioliformia, perforatione simplici, in pariete trachearum pori foveolati parvi, compressi, orificio fissurae simili. Altitudo cellularum radiorum medullarium 16–20 μ, cum exceptione 35 μ.

Descr. **C.** suggests some genus belonging to *Ulmaceae*. The wood is ring-porous, since on the annual ring boundaries the vessels with wide lumina are situated partly solitarily, partly in pairs, densely beside each other. At some places, however, the vessels with wide lumina near the annual ring boundary are concentrated in smaller groups and are full of tyloses. The early vessels at the annual ring boundary are comparatively large, they may reach a diameter of 350 and even 400 μ, but most of them are somewhat narrower than that. In the groups there is, as a rule, a larger vessel surrounded by the tracheae of narrower lumina and the vasicentric parenchyma. Such a cross-section structure definitely differentiates the fossil from both *Ulmus* and *Celtis*. The diameter of the vessels diminishes towards the late wood where it hardly reaches 100–110 μ. The ground substance consists of thick-walled xylem fibre, but tracheids with narrower lumina and thin-walled parenchyma cells are frequent which concentrate into smaller or larger groups near the vessels. This structure is highly suggestive of *Ulmaceae* and in certain respect also of *Sapindus*.

T. The characteristic rays of homogeneous structure are 10–15 cells high, but also rays of 50 cell height and 4–6 cell width occur among them. Thus some rays are 6–10 times as high as wide. This again shows a sharp difference as against *Celtis* and *Ulmus* in which the rays are more of short spindle shape. The cross sections of the ray cells are circles of equal size, so the rays can be regarded homogeneous. *Celtis* no more enters into consideration, since its rays are heterogeneous, that is at their margins and sides the ray cells are much larger than in their interior. Along the rays, as a rule, a row of parenchyma cells extends which contain rhombohedral crystals. Almost in all cells a single crystal is found. The vessels consist of short members; in their walls dense bordered pits touching each other with compressed borders are found, the apertures of the bordered pits are slit-like. Spiral thickenings occur in some vessels and tracheids. Between the parenchyma cells and rays thick-walled xylem fibres are grouped in bundles (Fig. 4). Such anatomical features support our assumption that the fossil may have originated from some species of *Ulmaceae*.

R. The homogeneous structure of the rays is distinct. The height of the ray cells is 16–25 μ, higher ones occur in the rarest cases. Very exceptionally the height of the extreme marginal parenchyma cells may be 35 μ and the length of the procumbent rectangles even 110–120 μ. In the radial walls of the rays tiny point-shaped pits are aligned generally parallel to the horizontal wall.

Note: The cross section, tangential and radial structure of the fossil is perfectly suggestive of *Ulmaceae*, and within these of *Zelkova*, therefore our fossil is certainly a *Zelkovoxylon*. As to the species, the determination of the fossil raises more difficulties since it does not perfectly agree with any of the recent *Zelkova*.

We name the fossil, after the eminent Soviet xylotomist Yatsenko-Khmelevsky, *Zelkovoxylon yatsenko-khmelevskyi* n. sp.

L. Nógrádszakál; **A.** Lower Sarmatian.

The original material is in the Hungarian National Museum under No. 31.

Ulmoxylon scabroides n. sp.

Plate LXXVII, Figs 1–9.

Diagnosis: Lignum annulariter porosum, diametro trachearum priorum 140–150 μ. In stratis concentricis turmae minores-majores trachearum tracheidarumque. Textum fundamentale e fibris ligni luminibus valde parvis constitutum. Dispositio trachearum turmarumque trachearum in sectione transversali similis Ulmi scabrae. Structura radiorum medullarium homogenea. Membra doliiformia trachearum contignationi similiter inter seipsa accommodata. Tracheae spiraliter porisque areolatis densis structae.

Descr. **C.** A characteristic structure immediately suggests some species of the *Ulmaceae*. The annual ring boundaries—although the wood was received for examination in an entirely compressed condition—are rather well noticeable (Fig. 1). The diameter of the large vessels of the early wood is 140–150 μ; the early vessel series is followed in the ground substance by bundles of 2–3 vessels with minor lumina; at the limit of the late wood the lumina of the tracheae are narrowing down and their diameter is no more than 15–20 μ. The ground substance consists of thick-walled xylem fibre, the lumina are almost point-shaped. The 2–5-seriate rays run at a distance of 1–5 vessels. Their interior is filled with a dark content. The cross section is suggestive of *Ulmaceae*, but a more exact determination can be carried out only by examining the tangential and radial slides.

T. The rays are 3–25–30 cells high and of homogeneous structure, since the marginal cells are of the same size and shape as the internal ones (Figs 5 and 6). Between the rays thick-walled xylem fibres, and among these sporadically parenchyma cells are found. The members of the broader vessels are widening somewhat barrel-like and are storeyed (Fig. 4). In some longitudinal parenchyma cells calcium oxalate crystal rows are found. Such ray skeleton is primarily indicative of *Ulmus* and *Zelkova*.

R. The ray cells are elongated procumbent rectangles (Figs 7 and 9). In the rays the average height of the ray cells is 29–30 μ; in a ray of 660 μ height there were 20 ray cells, which corresponds to an average cell height of about 30 μ. Only the marginal cells are somewhat higher here and there, without pointing to a heterogeneous structure (Figs 5 and 6). The horizontal length of the ray cells ranges between 200 and 220 μ. The simple perforation of the vessels can only be suspected at some places, similarly to the dense arrangement of the bordered pits in the walls of the tracheids and fibre tracheids. The *Ulmus* character is verified also on this side by the rather frequent calcium oxalate crystal rows (Fig. 9).

Note: Since the pictures of cross, tangential and radial slides perfectly agree with the recent *Ulmus* species, we regard the fossil as *Ulmoxylon*. Of the living *Ulmus* it exhibits perhaps greatest similarity to *U. scabra*, therefore we designate the fossil with the name *Ulmoxylon scabroides*.

It is possible that the fossil can be identified with one of those species the leafs or fruits of which have already been found as imprints. Andreánszky (1959), for instance, described from Buják and Nógrádszakál eleven different *Ulmus* species on the grounds of leaf imprints, and mentions also *Ulmus* stems of very good preservation. He also publishes the cross-section picture of one of these, which, however, does not agree with our fossil.

L. Sámsonháza; **A.** Helvetian.

Ulmoxylon sp. (cf. *Ulmus scabra* Mill.)

Plate LXXV, Figs 6–10.

Descr. **C.** The structure of the wood is characteristic of *Ulmaceae*. On the annual ring boundary the vessels with wide lumina lined with tyloses sometimes concentrate into smaller multiples. The diameter of the vessels is 450–500 μ, but they can be smaller and may be arranged in two rows above each other. The tracheae in the annual ring are arranged in smaller or larger multiples (Fig. 7), the size of the groups towards the late wood diminishes. They are surrounded by thick-walled xylem fibres (Fig. 8).

T. The rays are 1–8 cells wide and 50–60 cells high, the cross sections of the ray cells are equal, thus the rays are homogeneous. This structure markedly differs from *Celtis* and *Zelkova*, so the fossil can be ranged with certainty to the genus *Ulmus*.

In the wider vessels and narrower tracheids there are thin and dense spiral thickenings, which is another characteristic feature of the *Ulmaceae*. In the walls of the broad vessels tiny bordered pits appear, the borders of which are rounded (Fig. 11).

Note: Of the living *Ulmus* species indigenous in Central Europe the fossil is most suggestive of *Ulmus scabra*, therefore it could be named as *Ulmoxylon scabroides;* still we prefer not to give it any special name since its radial structure is not exactly known to us.

L. Szigliget, west side of Vilmahegy; **A.** Helvetian.

(Hungarian National Museum, No. 6852.)

Ulmoxylon cf. *carpinifolia* Gled.

Plate LXXVIII, Figs 1–4.

The perfectly silicified piece of wood is of milk-white colour, owing to which the finer details are hardly visible on the slides prepared of it. Even so its determination was possible.

Descr. **C.** reveals that the fossil must have originated from a broad-leafed tree and particularly from some *Ulmus* species. The annual rings are 3–7 mm wide. A ring-porous wood, since on the annual ring boundary the vessels with large cavities are situated beside each other or directly above each other in 2–3 rows. Most characteristic are the smaller or larger groups of vessels and tracheids in the annual ring arranged in somewhat oblique rows (see the framed part of Fig. 1). The radial diameters of the spring vessels are 240–250 μ, while their widths range from 100 to 120 μ. The diameters of the vessels can, however, be larger and smaller as well. In the multiples generally 6–10 vessels with wider or narrower lumina are found. The intervals of the vessels are filled with thick-walled xylem fibres and thin-walled wood parenchyma, which is a characteristic *Ulmus* design. In its cross-section structure it mostly resembles *Ulmus carpinifolia.* Between the vessels tri-seriate rays are seen. There is no difference as to the size of the ray cells, which also permits inference of *Ulmus*. In the vessels there are many tyloses.

T. exhibits the characteristic *Ulmus* structure. The rays are 20–80 cells high and 3–6–(8) cells wide. Beside them there are xylem fibres with narrow lumina and wood parenchyma cells, in the latter rather frequently calcium oxalate crystal rows are aligned, from which *Ulmus* can be inferred.

R. The height of the procumbent ray cells is rather moderate, 12–14 μ, their length is 70–120 μ.

Note: As regards anatomic features, the fossil must be some kind of *Ulmus.* The finer details point to *Ulmus carpinifolia.* The similarity is corroborated by the spring vessels at the annual ring boundary which are ellipsoid, while e.g. in *Ulmus levis* the cross sections of the spring vessels are circular, and the groups of vessels are not arranged in oblique rows either as they are in *Ulmus carpinifolia.* In the last analysis, the fossil to all probability shows closest resemblance to the common elm. and with some reservation we name it *Ulmoxylon* cf. *Ulmus carpinifolia.*

L. Pásztó; **A.** Sarmatian-Pannonian.

Ulmoxylon sp. Greguss

Plate XC, Fig. 12.

The polished sections prepared from the material collected by L. Bartkó (1966) from the Tortonian andesite tuff on the western slope, dissected by furrows, of Őrhegy Hill near Mátraverebély are unfit for detailed investigations. It is on the cross sections and perhaps even slightly better on the tangential sections that the belonging of these remains to the family *Ulmaceae* could best be established. Among the genera, *Ulmus*, *Celtis*, *Zelkova*, *Planera*, *Pteroceltis* and *Barbeia* may enter into consideration. Of these, *Ulmus* is the most likely, as the vessels of wide section are arranged in a ring on the borders of the annual rings and vessel diameters gradually decrease between the broad pith rays towards the late band. In the annual ring fields, the vessels of narrower section, the tracheids and parenchyma cells form clusters of various size. Compression by the sediment has unfortunately substantially deformed the size and shape of the cells. However, the decidedly homogeneous pith rays exclude both *Celtis* and *Zelkova.* The rays are 3 to 8 cells wide, 10 to 70 cells high in tangential section. Among the pith rays there are wood fibre bundles and wood parenchyma cells, a feature that also suggests *Ulmus.* No finer details could be recognized owing to the glass-like transparency of the wood and the compression of its texture, therefore the designation *Ulmoxylon* sp. has been given. Our specimen most resembles *Ulmus glabra* and may even be identical with it.

L. Mátraverebély; **A.** Helvetian.

Ulmus sp.

Plate LXV, Figs 7 and 8.

Descr. **C.** The annual rings are conspicuous. The first vessels of the spring wood are strikingly large and radially elongated, as is characteristic of a ring-porous wood. In the annual ring the tracheids and wood parenchyma groups and xylem fibres present a typical *Ulmus* or *Celtis* picture (Fig. 7).

T. The ray structure was well visible. The rays are 20–50 cells high and 3–6 cells wide, and perfectly homogeneous, the marginal cells do not differ from the interior ones in size. This structure is mainly suggestive of *Ulmus.*

A comparison of the cross and tangential slides with the Hungarian *Ulmus* and *Celtis* species revealed that it does not completely agree with any of them. There is no doubt, however, that it belongs to *Ulmaceae*, the more so since it has homogeneous rays and resembles *Ulmus* also in its structure.

L. Újfalu; **A.** Pleistocene.

Celtixylon campestre (Hofmann) n. comb.

Plate LXXIX, Figs 1–4.

The anatomy of the fossil may suggest some *Zelkova* species. The cross sections of the vessels, and even the ray structure of the fossil are more suggestive of *Zelkova* than of *Ulmus*, because the rays of the former are also of heterogeneous structure, and the marginal cells as seen in the fossil can be sporadically observed also in the rays of *Zelkova*. A simple comparison, however, readily reveals that the rays of *Zelkova* are less suggestive of the fossil examined than those of *Celtis*. The greatest width of the rays of *Zelkova* is 5–6 cells, while both in *Celtis* and in the fossil 10–12 cell wide rays or even wider ones are found. All these differences become most conspicuous if the photos of the same magnification (140×) of the tangential sections of the four kinds of wood are compared. On these grounds the fossil is most suggestive of the *Celtis australis* of the Mediterranean region, although it does not completely agree with it either (Fig. 3).

Considering all these facts, the correct denomination of the fossil determined as *Ulmoxylon campestre* is *Celtixylon campestre* (Hofmann) n. comb.

Note: Of the genera belonging to *Ulmaceae*, remains of *Zelkova*, *Celtis* and *Ulmus* occur. The fossil of Sümeg determined as *Celtites kleinii* by Tuzson (1906) belongs to *Ulmaceae*, but the determination as *Celtites*, considering the description and the coloured drawing, does not seem quite certain, since the anatomical separation of the *Celtis*, *Ulmus* and *Zelkova* can only be carried out on the basis of the structure of the ray skeleton. Tuzson, however, does not analyse this structure of the fossil.

Horváth (1954) in his study quoted determines *Ulmoxylon*, *Celtixylon* and *Zelkovoxylon*, and tries to identify one with *Ulmus americana*, the second with *Celtis occidentalis*, and the third with *Zelkova serrata*. Although there is no doubt as to the fossils permitting of *Ulmaceae*, the separation of *Ulmus*, *Celtis* and *Zelkova* is somewhat uncertain, because the heterogeneous ray is characteristic of *Celtis*, which does in no way appear in Fig. 14. This photo represents a homogeneous ray structure and so cannot be *Celtis*, but more likely it is *Ulmus*.

It would be more correct to designate all three fossils as *Ulmoxylon* sp.

L. Füzérkomlós; **A.** Sarmatian.

23. MELIACEAE

Meliaceoxylon matrense n. sp.

Plate LXXX, Figs 1–9.

Diagnosis: Limites stratorum concentricorum vix conspicui. In texto fundamentali e fibris ligni constructo tracheae solitares, geminae, vel radios breves ex 3–6 poris efformatos constituentes. In texto fundamentali disperse meatus longitudinales, conspicue materiam aliquam continentes. Radii medullares latitudine 2–3-cellulares, heterogenei, apice uno, vel ambobus in altitudine 3–5 cellularum 1-stratosi. Tracheae parenchyma paratracheali humili circumdatae. In texto fundamentali campi minores vel maiores e cellulis parenchymaticis efformati.

Descr. **C.** In a diffuse-porous wood the annual ring boundaries are hardly perceptible, the vessels are single, paired, or multiples of 4–6 members which are not equal in size and are radially arranged; towards the late wood the tracheae become somewhat narrower. The ground substance is homogeneous xylem fibre among which parenchyma cells are dispersed. In the ground substance here and there single cells occur, the walls of which are comparatively thin; they are surrounded by parenchyma cells. In some of them there is a dark and gold-yellow resin-, rubber- or milk-like content, which permits inference of *Moraceae* and *Meliaceae* rather than *Lauraceae*. Such ducts never occur in *Lauraceae* in which idioblasts are found, while in the fossil described there are definite ducts (Fig. 3).

T. The rays are 1–3 cell layers wide and 15–20 cells high. The short paratracheal parenchyma cells which stick to the vessels are particularly characteristic, their shape is triangular or quadrangular and the quadrangles are squares or short oblongs.

R. Because of the high degree of disorganization and compression only the rays' heterogeneous structure could be established. The lower and medium cells are rather procumbent oblongs while the terminal ones are at an acute or right angle (Figs 8 and 9).

The fossil is regarded with great probability as belonging to *Melicaceae*, and we name it *Meliaceoxylon matrense*.

L. Mátranovák (Northwest Nyírpuszta and Barna-völgy); **A.** Lower Helvetian.

(Hungarian National Museum, Nos 201 and 202.)

24. EUPHORBIACEAE

Euphorbioxylon secretiphorum n. sp.

Plates LXXXI, Figs 1–9; LXXXII, Figs 1–9.

Diagnosis: In ligno radiisque latis medullaribus cavernae vel meatus longitudinales laticiferi, structura heterogenei. Textum fundamentale e fibris ligni constructum; tracheae perforationibus scalares. Radii medullares latitudine 1–8-cellulares, altitudine pluricellulares.

Descr. **C.** There are no conspicuous annual ring boundaries in the wood; it might have been diffuse-porous. The wood is perfectly homogeneous and in the ground substance the broad rays are highly compressed. It is a characteristic feature of the wood that in its interior, longitudinal ducts are found the diameter of which is 110–120 but in some cases exceeds even 200–250 μ (Plate LXXXI, Figs 2 and 3). The ducts are filled with a white granular substance, which in our opinion must have been milk-like. Between the rays of 10–15 cell width the tracheae are comparatively narrow; their distribution and shape are greatly reminiscent of the conditions observed in the fossil *Euphorbioxylon remyi*. The ducts are rather frequent, but no regularity could be established in their arrangement. At some places it appears as if 2–3 such ducts merged into a larger duct, in which case strikingly large ducts come into being (Plate LXXXI, Fig. 4).

T. The comparatively low but broad rays (Plate LXXXII, Figs 2 and 5) are characteristic. The rays are 1–12–15 cells wide and of heterogeneous structure since at the ends of the rays the marginal cells continue over a long sector (Plate LXXXII, Fig. 1). The horizontal ducts are rather frequent in the broad rays. The cross sections of the ray cells are polygonal, highly compressed (Plate LXXXII, Figs 4 and 6), their diameter is 20–25 μ. The intervals between the rays are filled partly with parenchyma, partly with tracheae and xylem fibres. In the cells there is a dark content.

R. The ray structure is clearly visible (Plate LXXXI, Fig. 5). The interior cells are more elongated rectangles, the marginal cells squares or upright oblongs, at other places they fit together in hexagonal form. The marginal cells are 50–60 μ long and 20–25 μ high, but their height may reach even 100 μ. The perforation of the tracheae is scalariform, no simple perforation occurs, the number of the bars may amount to 20–25 (Plate LXXXI, Figs 8 and 9, and Plate LXXXII, Figs 7, 8 and 9). The bars may sometimes branch in Y form. The distance between the bars is 7 μ, their thickness about 3 μ. The longitudinal parenchyma cells are rather frequent, sometimes 2 parenchyma cells are seen beside each other. The walls of the tracheae are covered with pits which often show a transition to scalariform perforation (Fig. 7). Sometimes it appears as if there were spiral thickenings in the walls of the vessels. Even 3 or 4 pits fall to the width of one vessel. The shape of the pits is a well-defined square or oblong (Plate LXXXI, Fig. 7). The longitudinal milk tubes are clearly seen on the radial side.

Note: There is no noticeable annual ring boundary in the fossil, which indicates that the tree may have lived under an equable climate. The longitudinal ducts containing a milk-like substance permit to infer a certain tropical environment. The comparatively broad rays and their long uniseriate endings suggest *Anacardiaceae*, *Meliaceae* or *Euphorbiaceae*. For *Euphorbiaceae* argues the circumstance that the endings of the broad rays are bordered at a 5 or 6 cell height by uniseriate parts. If we add the presence of longitudinal and horizontal milk ducts, the fossil can be ranged to the *Euphorbiaceae* with a high probability.

This assumption is supported by the fact that e.g. in the broad rays of the genus *Hieronyma* similar horizontal milk ducts are found. Also the presence of frequent scalariform perforations speaks for this family, within which we propose to separate it as a new species.

L. Szarvaskő; **A.** Helvetian.

Euphorbioxylon dorogense n. sp.

Plates LXXXIII–LXXXVI, Figs 1–16.

Diagnosis: Lignum disperse porosum, in sectione transversali sine limitibus stratorum concentricorum conspicuis. Tracheae solitariae, vel in radios breviores-longiores cumulatae. Inter tracheas cellulae laticiferae, magnitudine iis aequales, materiam albam continentes. Lignum cavis latis, inter ipsos distantia 2–3 mm. In sectione tangentiali radii medullares in latitudine 1–3-cellulares, e cellulis 10–30 superpositis, parietibus crassis. Inter ipsos cellulae laticiferae tenues distinctae. Tracheae thyllis praeditae. Textum fundamentale e fibris ligni et parenchyma pariete tenui formatum. Structura radiorum medullarium heterogenea. Tracheae poris areolatis circularibus, alternantibus, ostiola circularia, vel horisontaliter elliptica habentibus.

Descr. **C.** A diffuse-porous wood in which the annual ring boundaries are hardly noticeable. The rays are uni- or bi-, exceptionally triseriate and run generally at a distance of 1 or 2 vessels. The ground substance is xylem fibre in which the tracheae are single, or paired or clustered radially into shorter or longer multiples.

This reminds us of the structure of *Styracaceae*. At some places terminal parenchyma can be observed in the ground substance. In some elements, particularly in the thin-walled cells corresponding to the size of the vessels, there is a white granular substance which, to all probability, must have been milk-like, so these cells may be considered as the cross sections of the longitudinal milk cells, highly suggestive of the milk tubes occurring in *Euphorbioxylon remyi.* Figure 4 of Plate LXXXIII clearly shows that these cells probably contained a milk-like substance. The radial diameter of the tracheae is 100–150 μ, their width ranges from 60 to 70 μ.

It is a further characteristic trait of this fossil that in the ground substance at 2–3 mm distances, though sporadically, longitudinal ducts with a white content are found. Their interior or border is filled with epithelial cells (Fig. 2). The cross sections of these large ducts are radially somewhat elongated, their radial diameters are 200–400 μ while their widths range between 180 and 200 μ. The structure permits of the wood belonging to such a family or genus in which longitudinal milk tubes or rather extensive milk ducts are found; of the woody plants *Euphorbiaceae*, *Icacinaceae* and *Moraceae* primarily enter into consideration.

T. The presence of the milk cells or ducts can also be observed. The rays are 1–2, exceptionally 3 cells wide and in general 10–30 cells high. At the border of some rays the terminal cells are somewhat higher than the interior ones, which indicates a heterogeneous structure of the rays.

Most of the ray cells are filled with a dark content, but some cells seem to be quite empty, also their walls are thinner than those of the other ray cells.

Along the ray cells quite thin-walled parenchyma cells or wide tracheae are arranged. In the vessels there are many tyloses, in the walls the borders of the pits only touch each other without being compressed. The border is explicitly circular, the aperture is circular or horizontally elliptic (Fig. 8). Neither scalariform nor even simple perforation or any spiral thickening could be established in the vessels.

The cross section and tangential structure, as well as the presence of milk cells or broad ducts are suggestive of *Euphorbiaceae* and *Moraceae.* A great similarity of the milk cells makes likely also the relationship with *Euphorbioxylon remyi.*

Apart from these, the tangential slide shows another interesting feature which might permit to think of a scalariform perforation of the tracheae. This seems to be verified by Figs 10 and 11 of Plate LXXXV, where at the ending of two members of vessels corresponding to the bars the cell walls are repeatedly interrupted when the thickenings corresponding to the scales are opposed to each other. It is possible, however, that these interruptions of the cell walls correspond to the cross sections of the bordered pits arranged in the walls.

Neither could we distinguish definite scales nor did we succeed in elucidating whether the members of the tracheae communicate with each other by simple perforation or not.

R. The characteristics are seen on Plate LXXXVI. Figures 13, 14 and 16 verify the heterogeneous structure of the rays (Fig. 16), the content substance of the ray cells, the presence of the longitudinal parenchyma cells (Figs 13 and 14), and the striking thinness of all ray cell walls.

All these features, particularly the milk cells, display a great similarity to *Euphorbioxylon remyi*, and this close relationship is greatly supported not only by the cross section but also by the tangential and radial structures.

The relationship with *Euphorbiaceae* and *Moraceae* is corroborated by the fact that in this fossil, as well as in the best known representatives of *Euphorbiaceae* and *Moraceae*, the vessels are almost completely filled with a great amount of thin-walled tyloses, the presence of which makes it difficult to recognize the endings of the tracheae because it is almost impossible to decide which are the endings of the single vessel members and of the tyloses, respectively.

Since the fossil in some details definitely differs from *Euphorbioxylon remyi*, we distinguish it by the name *Euphorbioxylon dorogense* n. sp. after its site.

L. Dorog; **A.** Oligocene.

Euphorbioxylon remyi n. sp.

Plates LXXXVII, Figs 1–9; LXXXVIII, Figs 10–18.

Diagnosis: In sectione transversali elementa transportantes et cellulae tenues parenchymae ab iis magnitudine vix distinctae in seriebus conspicuis radialiter ordinatae. In seriebus his cava pariete tenua, radialiter porrecta, diametro sexties usque decies huius trachearum: tubi cellularum longitudinales transversaliter secti. Radii medullares in latitudine 1–2–4–(5)-cellulares, parietibus insigniter tenuibus. Radii medullares in latere tangentiali e cellulis 10–20 superpositis et structura distincte heterogenei. Tracheae longitudinales perforatione scalari, gradibus multis, in nonnullis locis etiam parietes laterales trachearum cooperientibus, gradibus crassis, hiatibus interpositis crassitudine aequalibus. In latere radiali cava longitudinalia materia albescenti repleta.

Descr. **C.** There are no conspicuous annual ring boundaries, they can be noticed only at some places. The wood which is very compact may be taken with a slight magnification for a tropical conifer, because it has no annual rings and the conductive elements are arranged radially, according to the same pattern as the tracheids are in the conifers (Fig. 1). With a higher magnification, however, in the radially arranged rows almost alternating with each other thick- and thin-walled elements, and among them radially arranged, remarkably thin-walled ray cells can be observed (Figs 2 and 3). In the continuation of the thick- and thin-walled elements at some places widening idioblasts with larger cavities are inserted (Figs 2, 3 and 12). The feeble magnification does not permit deciding whether these are really tracheae or not. Those with smaller lumina are probably vessels or xylem fibre and thin-walled parenchyma cells (Fig. 3). The cross sections of the vessels are squares or tangentially elongated oblongs, their walls thick, the lumina, however, always circular or elliptic (Figs 2 and 3). The exterior tangential extent of the tracheae is 50–60 μ, their radial diameter 30–40 μ, while the cavities of the idioblasts are of 180–250 μ radial diameter and of 40–50 μ width.

Whenusing higher magnification, the rectangular vessels frequently enough are somewhat oblique radially, which may have resulted from compression (Fig. 2), but it is also possible that these are the characteristic cross-section shapes of the tracheae. In some cells a dark, rounded content is found. The larger cavities are generally radially elongated ellipses or of irregular shape, which may be partly due to compression, but only partly, because in those cells which immediately join the tracheae no such degree of compression is seen.

Under still higher magnification it can be definitely established that the cavities referred to are, to all probability, cross sections of some longitudinal ducts, or possibly of sinuous milk cells. This assumption is verified by the thin walls of the ducts. In the ducts a white content remained. Very exceptionally 2 or possibly 3 such ducts can be seen beside each other appearing at first sight as short pore rays of 2–3 members (Fig. 6).

T. The multitude and density of the rays is remarkable. They are generally uniseriate, but bi- and triseriate ones are also frequent. The cross sections of the ray cells are generally polygonal, in the biseriate rays alternating and rather hexagonal. The biseriate ones very often continue above and below as uniseriate. The cells of the uniseriate sector are somewhat higher than the interior ones, thus the rays are of heterogeneous structure. In most ray cells there is a rounded dark cell content which is probably a resin-like substance. Between the rays thin-walled xylem fibres and parenchyma cells are arranged (Figs 3 and 5).

R. The heterogeneous ray structure is still more conspicuous. The interior cells of the rays are procumbent parenchyma cells, while the marginal ones are mostly squares or upright oblongs. The height of the interior procumbent ray cells is 15–18 μ while that of the marginal cells may reach 40–50 μ. In the ray cells the diameter of the rounded resin grains is mostly 20–30 μ, but sometimes the whole cell is almost filled with a mass of resin. There are hardly any ray cells without such rounded cell content. In some parenchyma cell crystals seem to appear.

Here and there also the structure of the longitudinal ducts could be observed. The mass filling the interior of the sinuous milk tubes is a whitish, disorganized substance. The radial widths of these ducts perfectly agree with the diameters of the cavities observed on the cross section, also their content is the same (Figs 12 and 15), supporting the assumption that the wood is permeated by sinuous tubes with some whitish contents (Figs 15 and 18).

In most rays it can be easily observed that all walls of the ray cells are remarkably thin and a very tiny pitting appears on them.

Scalariform perforations can be definitely established in the walls of some of the tracheae. The bars are rather broad and gradually diminish towards the endings of the vessels. The bars are as wide as the gaps between them. The number of the bars is very high on the radial side of the vessels (Figs 13 and 14).

Note: The marked compactness of the wood, the absence of annual rings, the extraordinarily small tracheal cross sections, the presence of the longitudinal ducts, the thin walls and the whitish content, the characteristic scalariform perforations in the radial walls of the vessels, the thick bars and their diversified forms, are all such anatomical features as never occurred together in any of the recent or fossil forms with which the author has become acquainted so far. The most characteristic feature of the fossil is that it exhibits cross sections of cavities which are not lumina of vessels because the walls are very thin and no pitting whatsoever could be established in them (Figs 2, 3, 6 and 12). In the author's opinion, these are elongated canals, and no oviform cells, since on the longitudinal slides the cylindrical structure of the substance filling the ducts definitely proves this assumption (Figs 15, 16, 17 and 18).

Metcalfe and Chalk (1950) refer to several families which contain canals with a milk-like substance. From woody plants *Caricaceae*, *Eucommiaceae*, *Euphorbiaceae*, *Flacourtiaceae*, *Icacinaceae*, *Moraceae* and *Oleaceae* may enter into consideration. It could not be established with which of these the fossil is identical. Since there are tubes with whitish, milk-like substance in the wood, the generic name *Euphorbioxylon* fits the fossil. I want to designate the fossil in the honour of Prof. W. Remy as *Euphorbioxylon remyi* n. sp.

L. Nógrádszakál; **A.** Sarmatian.

SYMPETALAE

25. EBENACEAE

Diospyroxylon cf. *ebenaster* Retz

Plate XC, Figs 2, 3, 6, 7, 9–11.

Diospyroxylon sp.

Plate XC, Figs 4, 8 and 8a.

In 1965, A. Tasnádi-Kubacska found a fossil tree trunk at Ipolytarnóc on the hillside above the locality with the vertebrate footprints. On the basis of its external appearance, the fossil was first believed to be a pine similar to *Pinus tarnócziensis*. A more detailed investigation, however, xylotomy in particular, revealed the fragment to be a vestige of a deciduous tree presumably belonging to the genus *Diospyros* of the *Ebenaceae*.

It was in the course of investigating this trunk fragment that the author received slides of a silicified trunk fragment found by T. Báldi in a road cut between Törökbálint and Érd.

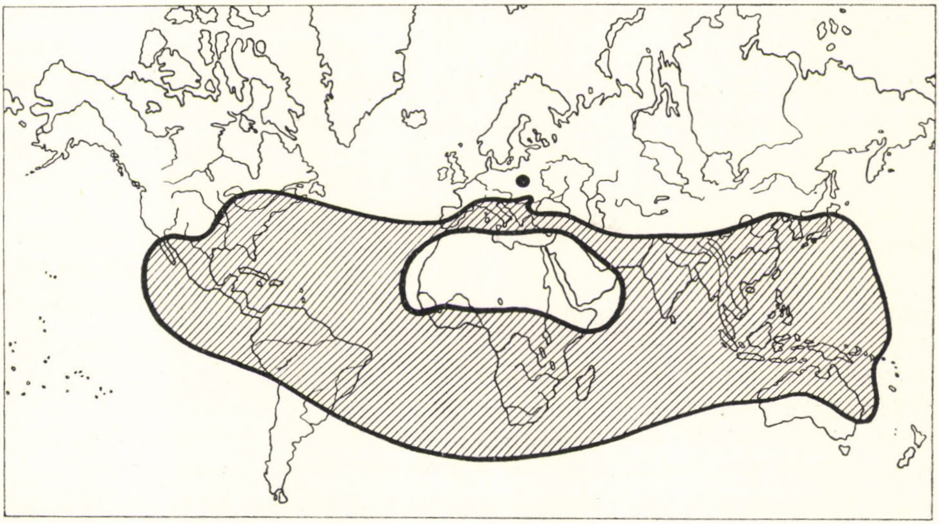
C. of the Ipolytarnóc fossil is shown in Figs 2 and 3. Annual rings are very vague, almost unrecognizable. The annual ring fields of the thick-walled wood fibres between the radial uniseriate, seldom biseriate pith rays are interrupted by parenchyma bands parallel to the annual rings (Fig. 3). These bands are spaced 6 to 12 wood fibres apart. This cross-sectional structure would admit *Juglanda-*

ceae, more exactly *Pterocarya* (Plate XC, Figs 2, 3 and 4). It also resembles *Ebenoxylon knollii*, one specimen of which was described by E. Hofmann (1939); another specimen was collected on Darnó Hill in Heves County and identified by Greguss (Plate LXXXIX, Fig. 1).

T. In the tangential section of the Ipolytarnóc fossil, pith rays are seen to be uniseriate almost without exception (Figs 6 and 7), exactly as in living *Diospyros ebenaster* Retz (Fig. 5). The height of the rays is variable in both; some may be as much as 30 to 40 cells high. Biseriate portions largely occur about the middle of the tallest rays. This structure is substantially different from *Ebenoxylon knollii* of Darnó Hill, whose pith rays are largely biseriate and at most 30 cells tall (Plate LXXXIX, Fig. 4). Calcium oxalate crystals are abundant in the parenchyma cells of living *Diospyros ebenaster* Retz (Fig. 5), as well as of the Darnó Hill and Ipolytarnóc fossils (Plate LXXXIX, Fig. 7, and Plate XC, Fig. 7, respectively). This is a difference from living *Diospyros lotus* L. whose cells contain no such crystals. Tangentially, the Ipolytarnóc fossil differs in essential features from the Darnó Hill fossil and rather resembles living *Diospyros ebenaster* (Fig. 5). Both fossils belong, however, beyond doubt to the *Ebenaceae*. The Lower Helvetian age established for the Ipolytarnóc fossil agrees with that of Báldi's fossil from Törökbálint, whose cross-sectional structure also resembles both living *Diospyros ebenaster* and the Ipolytarnóc fossil (Fig. 3). In tangential structure, the Törökbálint fossil differs substantially from both and also from the Darnó Hill fossil, in that its pith rays are bi- and triseriate, locally even quadriseriate (Fig. 8a) and that its tri- and quadriseriate rays taper near their ends characteristically, becoming uniseriate in a depth of 6 to 8 cells.

The above remarks lead to the conclusion that the four similar cross-sectional structures might very well represent four distinct species. The Ipolytarnóc fossil presumably stands closer to *Ebenoxylon egypticum* described by Kräusel, or to the form *Ebenoxylon ebenoides* (Schenk) Eduard, or even to the fossil from Ófalu in Baranya County, identified by Staub as *Diospyros parasitica* Etg., also of a similar (Helvetian) age. There is a remarkable similarity in the very fine bordered pitting of the vessels between living *Diospyros ebenaster* (Fig. 5) and the Ipolytarnóc fossil (Figs 9, 10), and also in the heterogeneity of the pith rays of both forms. However, in the absence of more precise and fine details, there is insufficient evidence for establishing a new species. In summary we may state that the Ipolytarnóc and Törökbálint fossils agree with living *Diospyros ebenaster* in cross-sectional structure, in the abundance of calcium oxalate crystals, and in the heterogeneity of ray structure; however, the Ipolytarnóc fossil differs substantially in tangential ray structure from the Törökbálint fossil, whereas it is nearly or even fully identical in this respect with the living species. On these grounds, we prefer to call the Ipolytarnóc fossil *Diospyroxylon* cf. *ebenaster*, and to identify the Törökbálint fossil in lack of more conclusive evidence as *Diospyros* sp.

Note: The several forms of *Diospyros* (*Ebenaceae*) encountered so far in the Hungarian Miocene and Oligocene suggest that, in that period, *Ebenaceae* had



Map 8. Recent distribution of the *Ebenaceae* (after Berry). Hungarian Oligocene sites (black spot)

been fairly abundant in the foreland of the Hungarian Mountains in Transdanubia as well as east of the Danube, and also in Baranya County. Most fossils are unsuitable for a detailed investigation, owing to the decay particularly of the finer structure of the longitudinal elements, vessels, wood fibres, wood parenchyma cells. Staub's *Diospyros* is Aquitanian, the Bánhorváti, Mád, Erdőbénye, Mikófalva, Buják, Ipolytarnóc and Törökbálint finds are Helvetian and the trunk fragments scattered over the Oligocene relief of Darnóhegy are probably the erosion residues of Helvetian sediments. Hence, the genus *Diospyros* thrived in Hungary from the Oligocene up to the Sarmatian, indicating a temperate subtropical flora when collated with the rest of the floral evidence.
Diospyroxylon cf. *ebenaster*; **L.** Ipolytarnóc; **A.** Burdigalian.
Diospyroxylon sp.: **L.** Érd–Törökbálint; **A.** Helvetian.

Ebenoxylon knollii Hofmann

Plate LXXXIX, Figs 1, 4, 6 and 7.

This fossil has been recorded for the first time by Greguss (1954) from the mount Darnóhegy in Heves county.

The fossil stems No. 2 to No. 8 collected at Sirok originate from dicotyledonous trees. The most important anatomical features verify that the records No. 2 and No. 5 could have belonged to *Ebenaceae*.

For lack of comparative material, specific determination encountered some difficulties, but the examinations of Hofmann (1943) have greatly facilitated the task.

The pieces No. 2 and No. 5 of Darnóhegy fully agree with *Ebenoxylon knollii* Hofmann, and therefore we feel justified in identifying them as such.

L. Sirok, Darnóhegy; **A.** Oligocene.

Ebenoxylon hofmannae Greguss

Plate LXXXIX, Figs 3, 5, 8 and 9.

Note: The silicified stems No. 3 and No. 6 originate from the two-branched valley of the Darnóhegy and from the place above the exterior Dalla highway. Anatomical properties may suggest the genus *Diospyros*. The sections prepared from recent species, the recent photo published by Müller-Stoll (1947) (Fig. 2), the photographs of Huber and Rouschal (1954, p. 79), and the wood structures of the already discussed *Ebenoxylon knollii* and of the stems No. 3 and No. 6 of Darnó by and large agree. There is no conformity with *Diospyros lotus*, since this species does not contain calcium oxalate crystals whereas the specimen examined does.

As to *Ebenoxylon knollii*, it cannot be identified with that species because of the different ray structure, different height of the rays, low amount of parenchyma cells containing crystals and the lamellar arrangement of the parenchyma (Fig. 3).

L. Sirok, Darnóhegy; **A.** Oligocene.

26. OLEACEAE

Fraxinoxylon komlósense Greguss

Plates XC, Fig. 1; XCI, Figs 1–3; XCII, Fig. 1.

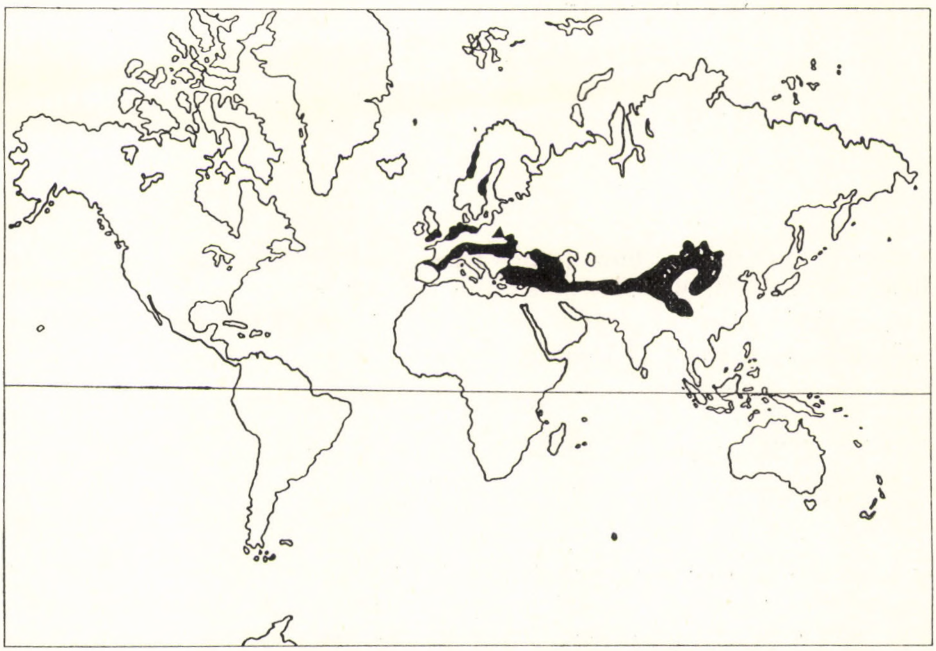
The material could have originated from a *Fraxinus* species already extinct, since several *Fraxinus*es are known from the Miocene which in some respect differ from the species living to-day. The form also definitely differs from the species *Fraxinoxylon excelsior* of Hofmann (1939).

Hofmann (1928) described a fossil determined as *Fraxinus* from the environment of Szombathely. The photograph published has proved the determination correct.

Andreánszky (1959) publishes a *Fraxinoxylon* from Mikófalva.

We also refer to the determination of the *Fraxinoxylon* fossil collected in Egerszalók.

V. Széky-Fuchs (1959) described a Sarmatian silicified stem from the Kánya-



Map 9. Recent distribution of the genus *Fraxinus* (after Krüssmann). Hungarian fossil sites (triangle)

hegy near Telkibánya, according to the determination of Andreánszky, also as *Fraxinus*. This fossil is most suggestive of *Fraxinus americana*.

L. Füzérkomlós; **A.** Sarmatian.

Fraxinoxylon cf. *Fraxinus excelsior* L.

Plates XCI, Fig. 4; XCIII, Figs 1–4.

(See Legends to the Plates.)

L. Pestszentlőrinc; **A.** Pleistocene.

GEOLOGICAL DESCRIPTION*

On the basis of the structure of wood types described in the Systematic Description, and of the stratigraphic position of the sites, we can establish the palaeogeographical and palaeoclimatic conditions that prevailed in the corresponding periods in the territory of Hungary.

PALAEOZOIC

PERMIAN

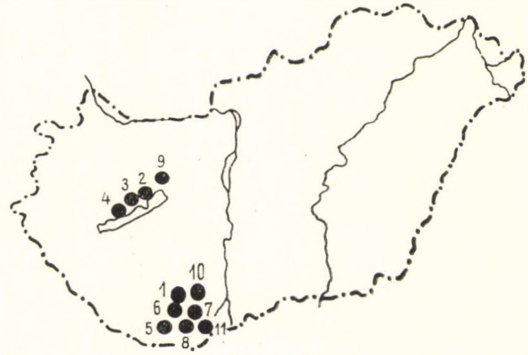
All pieces examined were gymnosperms of the *Conifer* type. No conspicuous annual ring boundary appears in any of them, which phenomenon unconditionally points to an equable climate. In the first group we range the *Baiera* of Boda, that is essentially the *Ginkgo*-like stems. The locality Boda is the first where besides the *Baiera*-like leaves also *Ginkgo*-like stem remains (*Baieroxylon implexum*) came to light. It is also probable that leaf and stem had belonged together, though they came to light separately.

To the second group may be classified those *Dadoxylon* species of Boda (*Dadoxylon schrollianum*, *D. transdanubicum*) which by a complete identity of their wood anatomy may be regarded essentially as *Araucarioxylon*s in the author's opinion, the more so since some of these have no such xylotomical properties as were not present in recent *Araucariaceae*. We are well aware that some research workers hold different opinion, still we claim that if the anatomy of a silicified stem perfectly agrees with that of some living *Araucaria*, we justifiedly consider it as *Araucarioxylon*. In our opinion the collective denomination of *Dadoxylon* is correct in those cases when the stem structure differs from the anatomy of the recent *Araucariaceae* and thus cannot be identified with them.

The third group comprises the fossils of the environment of Pécs (Pécs–Mecsekalja, Cserkút, Hetvehely) described earlier under the name *Ullmannites rhodeanus* (Tuzson 1913) and those from the region of the Lake Balaton (Balatonalmádi, Balatonszepezd, Balatonkövesd). In our opinion these primitive conifers are essentially also *Araucariaceae*, their anatomy of stem fully coincides with

* The author here recapitulates also the specimens described inhis *Fossil Gymnosperm Woods in Hungary from the Permian to the Pliocene* (1967), so that this chapter is a summary of the results of his research on both gymnosperms and angiosperms.

that of living *Araucaria* species. Also the *Araucaryoxylon spirale* that came to light from the Helvetian gravel of Mánfa belongs to this group. According to Vadász, it is an erosional remain originating from silicified stems frequent in the Permian layers of the Mecsek.



Map 10. Fossil stems from the Permian

Bakonya (1), Balatonalmádi (2), Balatonkövesd (3), Balatonszepezd (4), Boda (5), Cserkút (6), Hetvehely (7), Kővágószöllős (8), Litér (9), Mánfa (10), Pécs–Mecsekfalu (11)

The fourth group consists of such conifers (*Platyspiroxylon*) in the tracheids of which between the araucaroid pits comparatively broad and flat spiral thickenings are found which greatly remind us of the so-called callitroid thickenings of some recent *Callitris*. This conifer became known from the Permian layer of Bakony, Kővágószöllős, Litér, Hetvehely.

It is a common property in all woods examined that a 1–3 rowed araucaroid pitting is characteristic in the tracheid walls. Modern pitting can be found at most here and there in the wood of the *Baieroxylon* examined. This observation is in harmony with the results obtained so far.

The geographical distribution of the Permian records worked out is shown in Map 10.

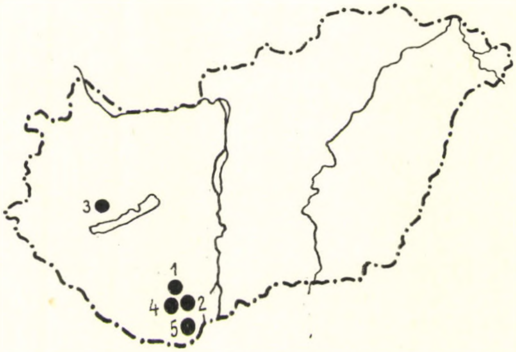
MESOZOIC

JURASSIC

From the mesozoic layers of Hungary rather few silicified stem pieces have been exposed. This is due to the sediments being mostly marine deposits. From the Raiblian calcareous marl of Csővár, Oravecz collected a wood remain of fusain character which points to a primitive conifer (*Dadoxylon*). Silicified stems of the Jurassic came to light from the area of Urkut, Vasas, Komló, Villány and Pécsbányatelep.

Characteristic traits of the Liassic stems are a similarity of their cross-section structures and the conspicuous absence of annual ring boundaries. Their finer interior structure, that of the rays, and the pitting of the longitudinal tracheids, however, show some differences from which we may infer different taxa.

By the tangential ray structure, generally two types can be distinguished. One is definitely araucaroid. Such are the records of the Upper Liassic of Urkut and the Dogger of Villány. The other fossils from the Lower Liassic of Pécsbányatelep and Vasas, however, exhibit a different ray structure when the photographs are compared.



Map 11. Fossil stems from the Lias and Dogger (Bath)

Komló (1), Pécsbányatelep (2), Urkut (3), Vasas (4), Villány (Bath) (5)

Two types are manifest also in the pitting of the longitudinal tracheids. In one of these the bordered pits in the longitudinal tracheid walls are arranged in one or two rows but according to the typical araucaroid pattern. In the other type there is no such close connection between the pits, which even if arranged in several rows, are not compressed honeycomb-like. Some pieces still bear such characteristic features as are indicative at least of the main types.

From the Lower Liassic of Pécsbányatelep, Vasas, and Komló, we became acquainted with an *Araucarioxylon*, from the Upper Liassic of Urkut with an *Araucarioxylon*, *Agathoxylon* and *Platyspiroxylon*, from the Upper Dogger of Villány with a further *Araucarioxylon.* All are gymnospermous, viz. conifer species, by and large of similar features. It can be also established that there are no conspicuous annual ring boundaries, and only in some of them some kind of vague periodicity could be suspected; so these woods must have lived in the Liassic under an equable climate.

Among the fossils, similarly to the Permian, members of these two types came to light. Even in the Jurassic araucaroid *Araucarioxylon*s (Vasas, Komló, Urkut, Villány), conifers similar to recent *Callitris* (*Callitroxylon* Pécsbányatelep) and *Platyspiroxylon*s were living in the territory of Hungary. The two last-mentioned types definitely differ from the *Araucariaceae*, as well as from the fossil determined by us as *Dadoxylon*. *Platyspiroxylon* and *Callitroxylon* are somewhat suggestive of recent verticillate *Cupressaceae*, while the anatomical features of *Araucarioxylon* and *Agathoxylon* point to recent *Araucariaceae*.

From this phenomenon it can be established beyond doubt that at least 2 or 3 different gymnospermous types must have lived, probably in a dry and warm environment, also during the Liassic.

It is interesting to note that the bordered pits of the tracheids of the one type are arranged in the araucaroid while those of the other partly in the araucaroid, partly in the so-called modern pattern. Both types have longitudinal parenchyma cells, and the cross fields of the rays contain usually not only one but several simple pits.

It is a further common anatomical feature that all walls of the longitudinal parenchyma and ray cells are thin and smooth; pits or other thickenings cannot be observed, not even exceptionally. In some *Araucaria*, or more exactly *Agathoxylon* species, the longitudinal parenchyma cells are filled at places with a dark resin content.

The *Araucaria* and *Callitris* species are living at present in the humid or dry, rainless tropical or subtropical areas of the southern hemisphere.

The Hungarian silicified gymnospermous woods from the Jurassic and the recent *Araucaria* or *Callitris* must have lived under similar conditions.

CRETACEOUS

In the Central Mountains of Transdanubia, stem remains have been exposed from the Cretaceous layers at several places. From the Lower Cretaceous at Urkut, Lábatlan, Tata, Hárskút, Szentgál, Sümeg, Zirc; from the Upper Cretaceous (Senonian) in the environments of Ajka.

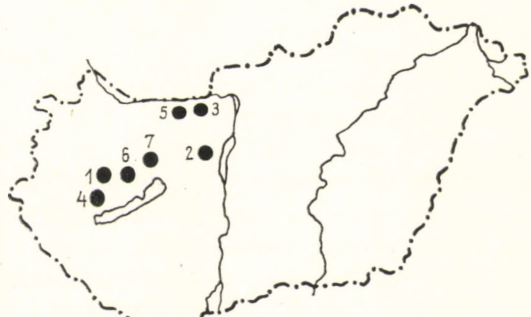
In contrast to the primitive forms of the Permian and Liassic, already the newer types appear. Among the fossil woods of Tata there were an *Araucarioxylon* and four *Podocarpoxylon*s; at Lábatlan a *Dadoxylon* and a *Podocarpoxylon* highly suggestive of *Mesembryoxylon;* both from Ajka and Zirc a *Podocarpoxylon;* from Urkut one more *Agathoxylon* sp., further *Brachyoxylon urkutense*, another probable *Brachyoxylon* and two kinds of *Araucaria* came to light.

The determination of *Torreyoxylon boureaui* originating from the Lower Cretaceous of Urkut and belonging to *Cephalotaxaceae* deserves special attention.

A comparatively great number of *Araucaria*-like conifers from the Upper Liassic and the Cretaceous of Urkut bear evidence of the fact that they formed varied forests in the Liassic and still in the Cretaceous.

The structure of the Cretaceous fossils is more varied than that of the stems from the previous epoch. Apart from *Araucaryoxylon*s there lived *Dadoxylon*s which in their anatomical properties somewhat differed from recent *Araucariaceae.* Such features could have been, e.g., the occurrence of 2 or 3 seriate rays. There are no such broad rays in recent *Araucariaceae*, therefore to distinguish them, for the time the collective denomination *Dadoxylon* seems to be justified.

As a new type appears the *Podocarpaceae*, in the cross-section structure of which, in contrast to *Araucariaceae*, angular tracheids and in the longitudinal slide comparatively high rays were dominating. In the cross fields podocarpoid pitting was more characteristic. Also longitudinal parenchyma cells frequently occurred, but their walls were thin and unpitted as it was the case with *Araucariaceae* and *Callitris.* Since in the cross fields generally only



Map 12. Fossil stems from the Cretaceous

Ajka (1), Hárskút (Szentgál) (2), Lábatlan (3), Sümeg (4), Tata (5), Urkut (6), Zirc (7)

1 or 2 podocarpoid pits occurred, they had to be sharply distinguished from *Dadoxylon* and *Araucaria*.

As a further type appears a Lower Cretaceous fossil of Lábatlan, the interior structure of which is somewhat reminiscent of *Podocarpaceae*, while some properties suggest *Cycadaceae*. The wood zones were periodically interrupted in the interior of this wood, which somehow became manifest also in the periodicity of the phloem rings. In our cross-section picture the radial tracheid rows run at a distance of 2 or 3 parenchyma cells, and this is no more *Conifer* but rather *Cycas* character. Since, however, in the longitudinal tracheid walls the bordered pits are closely aligned at some places while at others loosely in one row, we are inclined to think that the fossil may have been some kind of *Podocarpus*. This cross-section structure, however, does not preclude that the silicified stem might be a *Mesembryoxylon*, of which also the distinct ray structure is indicative.

All stem remains exposed from the Cretaceous are conifers and not a single angiosperm, that is mono- or dicotyledonous tree, is found among them. This by no means implies that no such plants of simple structure had existed in the Cretaceous since leaf imprints or pollen grains of *Magnolia*, *Liriodendron*, *Cinnamomum*, *Sterculia*, *Platanus*, *Smilax*, etc. have occurred, though no stem remains. From the absence of conspicuous annual rings in the stems examined and from the life form of recent related species it may be inferred that the Cretaceous trees represented by silicified woods must have lived in a tropical or subtropical climate.

Araucariaceae are today the characteristic evergreen trees of the islands of the southern hemisphere while some are living in South America and Australia. The *Podocarpus* species occur, however, also in the northern hemisphere, first of all in the littoral of the Far East and some penetrate as far as Japan. The *Torreya*s, on the other hand, are living partly in North America and partly in Southeastern Asia, Japan and Southern China in the society of *Podocarpus*.

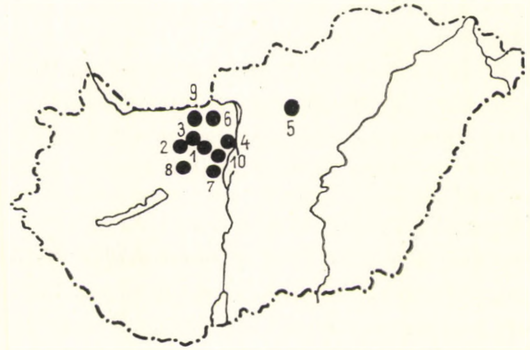
Summarizing the woody plants from the Cretaceous, considering the climatic demands of recent conifers of similar stem structure, they must have lived under subtropical conditions.

CENOZOIC

EOCENE AND OLIGOCENE

In contrast to the exclusively coniferous stems of the Mesozoic, in the Eocene and Oligocene overwhelmingly broad-leafed trees and palms are encountered. This, however, does not mean that no Angiosperms were living in this area in the Mesozoic. According to the palynological examinations of Góczán, angiosperms can be demonstrated with certainty, but silicified dicotyledonous or monocotyledonous stems were not examined. It is interesting to note that only such genera of both conifers and broad-leafed trees have so far come to light the nearest relatives of which are not living in Europe at present.

From the Lower Eocene coal layer of Tatabánya (Map 13) only the broad-leafed tree *Shoreoxylon holdeni* has been exposed. The geographical distribution of its relationship is limited mainly to Southeast Asia and its archipelago (see Map 5 on p. 54) the climate of which is tropical-subtropical. This equable climate is truly characterized by the absence of any conspicuous annual ring boundary.



Map 13. Fossil stems from the Eocene (1, 2) and Oligocene (3–10)

Budakeszi (1), Tatabánya (2), Bajna (3), Budakalász (4), Darnóhegy (5), Dorog (6), Solymár (7), Tata (8), Tokodaltáró (9), Üröm (10)

Also the pieces of stem exposed from the Oligocene point to an equable climate. In none of the fossils could we discern conspicuous annual ring boundaries, that is no early and late wood could be established in the histological structure of the conifers and broad-leafed trees examined. Also the occurrence of a palm in Dorog marks a warm climate. The climatic conditions of the palms is demonstrated by the map of Kaul (Map 1). Their present distribution mainly falls between the two tropics. Palm remains have been exposed from this period of Europe and North America from several sites.

Among the conifers *Podocarpus*, *Dacrydium* and *Torreya* are plants indicating oceanic warm or subtropical climate. We could not observe distinct annual ring boundaries, or more exactly early and late zones, in the wood of these species either. From Dorog also a *Sequoia* belonging to *Taxodiaceae* came to light, the direct relatives of which do not live in Europe either, although the last living relicts of *Sequoiae* are found in the moderately warm regions of North America, and these environmental conditions are also manifest in the structure of the wood. In the Oligocene fossils examined, however, the annual ring boundaries are not conspicuous, and no such differences between the spring and autumn wood appear to indicate any extreme climatic conditions.

The broad-leafed trees examined are also generally featured by the absence of conspicuous annual ring boundaries, only in one of the records of Dorog, *Quercoxylon böckhianum*, the spring wood composed of cells of wide lumina differs from the late wood so that the annual ring boundary is quite distinct.

The interior structures of *Ebenoxylon*, *Icacinoxylon*, *Sterculioxylon*, *Laurinoxylon*, *Euphorbioxylon* or *Myristicoxylon* are all indicative of drier tropical, equable climatic conditions. The recent species of *Ebenaceae* are tropical and subtropical (see Map 8 on p. 97), *Icacinaceae* exclusively tropical; *Sterculiaceae* and most of the *Lauraceae* also live in the tropics. The genus *Cinnamomum* (see Map 2 on p. 38) is found mostly in the tropical and subtropical regions and about a hundred species of *Myristicaceae* also occur in the tropics. Also palms are characteristic plants mainly of the tropics and so are probably the affinities of the trees represented by the *Euphorbioxylons*.

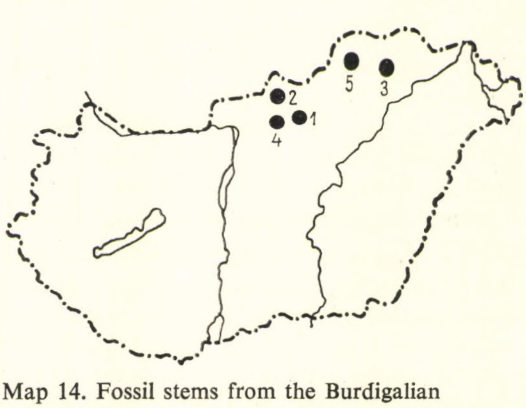
In connection with the Oligocene another interesting phenomenon deserves attention. In *Laurinoxylon*, *Myristicoxylon*, *Euphorbioxylon*, *Icacinoxylon*, *Sterculioxylon* and *Shoreoxylon*, oil or resin ducts and cells could be established. This also points to the fact that these trees had lived in sunny and warm areas, the rich oil and milk content being probably due to the economy of evaporation. Of special interest are in this respect the records exposed from Dorog where representatives of the families *Icacinaceae*, *Lauraceae*, *Euphorbiaceae*, *Sterculiaceae*, *Myristicaceae* and *Palmae* lived together. With the only exception of *Sequoia*, the nearest extant relatives of all of these are found in tropical and subtropical regions and in drier environments. Summarizing what has been stated above, a mild warm but drier subtropical climate must have prevailed in the territory of Hungary, mainly in Transdanubia, during the Eocene and Oligocene.

MIOCENE

(a) Burdigalian

The wood remains originating from the Burdigalian of the territory of Hungary are suggestive of a somewhat more varied vegetation similar, however, to the Oligocene flora. It is interesting to note that besides the explicitly thermophilous palms, *Lauraceae* and *Icacinaceae*, and also plants of the temperate zone, appear in greater abundance. Of the characteristic conifers of the northern hemisphere, *Pinus*, *Sequoia*, and *Keteleeria* are remarkable. Probably also *Platanus* appeared in this period though its presence could not be established for certain. *Palms*, *Pinus* species and broad-leafed trees were living beside each other, which points to the earlier tropical and subtropical climate gradually becoming more temperate. This climate, however, still suffered laurel forests mixed with palms to thrive on extensive areas. In this respect the flora of Ipolytarnóc deserves special attention. Ipolytarnóc in Nógrád county is one of the earliest known sites of fossil plants of the Lower Miocene.

According to Jablonszky (1914) the related recent species are indigenous in Southeast Asia, the southern slopes of the Himalaya, the Mediterranean region, North America, the Caucasus, in short the records can be brought in closer relationship with the vegetation of the subtropical zones.



Map 14. Fossil stems from the Burdigalian

Becske (1), Ipolytarnóc (2), Király (3), Nagybátony (4), Romhánypuszta (5)

Rásky handed me over 22 silicified pieces of stems from her collection. Detailed xylotomical examination revealed that the flora of Ipolytarnóc abounded in subtropical elements, palms, *Lauraceae*, etc. Of the silicified stems, *Pinuxylon tarnócziense* (Tuzson) is represented, the nearest recent relative of which, according to the author, is *Pinus lambertiana* Dougl. living in the Sierra Nevada mountains. Also *Sequoioxylon* (*Taxodioxylon*) so widespread in the tertiary floras came to light, in addition to a *Palmoxylon sabaloides*, two *Laurinoxylon* species, *L. aniboides* and *L. müller-stollii*, a *Citronella* cf. *mucronata*, *Icacinoxylon silvaticum* and a *Carpinoxylon* of uncertain determination. Of the *Pinaceae*, *Keteleeria* or perhaps *Abies* had already appeared.

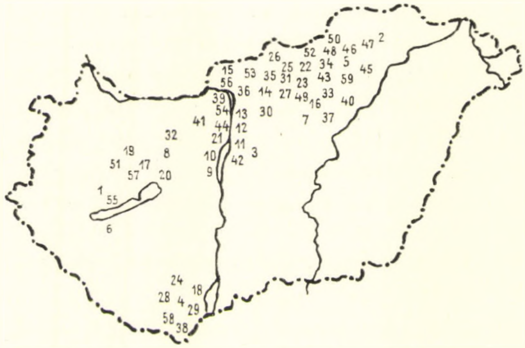
If only these conifers are considered, the coniferous forests of Ipolytarnóc must have lived under conditions similar to those in the western parts of North America, i.e. the present area of *Sequoiae*. A close association with *Lauraceae*, however, hardly permits these territories to be regarded as marshlands. *Citronella*, *Icacinoxylon*, *Laurinoxylon* and *Palmoxylon* beyond doubt indicate a warm climate, perhaps on the proximity of the ocean. Of the stems examined, only the genera *Pinus*, *Abies*, *Laurus* and *Carpinus* subsist in Europe today. The palms of Ipolytarnóc, as well as those from the Oligocene of Dorog, prove that contiguous palm groves still existed in the present area of Hungary in the Upper Oligocene and in the early Miocene. In the coastal territories laurel forests (*Laurus*, *Cinnamomum*, *Myristica*) mixed with plants of the temperate climate (*Quercus* and *Carpinus*) thrived.

From the Burdigalian derive *Laurinoxylon pálfalvyi* found at Becske, and one of the *Icacinoxylon*s of Nagybátony. Both of these being almost identical with the *Icacinoxylon* of Ipolytarnóc, we may infer that also the area of Nagybátony and Becske may have had a similar vegetation in the Burdigalian. Summarizing the xylotomy of the stem remains from the Burdigalian, we reached the conclusion that besides the tropical and subtropical elements there occurred also woody plants which could better support a temperate climate.

(b) Helvetian

The silicified woods of the Helvetian are in certain respects suggestive of the remains of the woody plants of the Burdigalian but they show a still greater variety. Both coniferous and broad-leafed tree remains were brought to light in a comparatively great abundance and variety. From the 99 silicified or carbonized stems 33 are conifers, 3 palms and 63 dicotyledonous plants. These figures of course do not signify the number of the determined species that lived in that period because the same forms (*Sequoioxylon*, *Laurinoxylon*, *Liquidambaroxylon*) were exposed from several Helvetian sites.

Conifers. Among the remains there are from *Cupressaceae* 2 *Widdringtonia*, 6 *Cupressinoxylon*s, from *Podocarpaceae* 2 *Podocarpoxylon*, from *Taxodiaceae* 1 *Cryptomerioxylon*, 10 *Sequoioxylon*s, 2 *Metasequoioxylon*s, 2 *Taxodioxylon*s and



Map 15. Fossil stems from the Helvetian

Ajka (1), Alacska (2), Alsó-Mátyásföld (3), Apátvarasd (4), Balaton (5), Balatonboglár (6), Bántapuszta (7), Bodajk (8), Budafok (9), Budaörs (10), Budapest (11), Budapest-Mátyásföld (12), Cinkota (13), Cserháthaláp (14), Diósjenő (15), Eger (16), Hárságy (17), Hidas (18), Homokbödöge (19), Iszkaszentgyörgy (20), Kamaraerdő (21), Karancsberény (22), Karancskeszi (23), Kárász (24), Kazár (25), Litke (26), Mátranovák (27), Mecseknádasd (28), Mecsekszabolcs (29), Mogyoród (30), Monosbél (31), Mór (32), Nagybátony (33), Nagyvisnyó (34), Nemti (35), Nógrád (36), Parádfürdő (37), Pécsszabolcs (38), Pénzeskút (39), Pereces (40), Pesthidegkút (41), Pestszentlőrinc (42), Piliny (43), Pomáz (44), Recsk (45), Sajókazinc (46), Sajószentpéter (47), Salgóbánya (48), Salgótarján (49), Sámsonháza (50), Sümeg (51), Szarvaskő (52), Szécsény (53), Szentendre (54), Szigliget (55), Szokolya (56), Városlőd (57), Vékény (58), Zagyvapálfalva (59)

finally from *Pinaceae* 2 *Laricioxylon*, 2 *Pinuxylon* and 2 remain determined as *Cedroxylon*. While *Widdringtonia* are the characteristic plants of the temperate regions of the southern hemisphere, more exactly of South Africa, the other conifers, that is *Sequoia*, *Metasequoia Taxodium*, *Pinus*, *Larix*, *Cedrus*, *Cryptomeria*, thrive under the temperate to warm-temperate climate of the northern hemisphere. The annual rings in most cases did not show conspicuously that the conifers referred to had lived under wide-ranging temperature. Only in some annual rings of pieces determined as *Cedroxylon*, *Sequoioxylon*, *Metasequoia* could the distinct and broad separation of the early and late wood be observed. Since these conifers, as judged from the diameters and the faculty of the annual rings are of different characters, some of the pieces might have derived from secondary sites.

Therefore even the Helvetian age of the fossils determined e.g. as *Widdringtonioxylon* is by no means certain. Baikovskaia (1956) mentions *Widdringtonia* imprints of the Miocene from several places. Thus we may regard both fossils as *Widdringtonia*. The anatomy of *Podocarpoxylon* and *Widdringtonia* definitely differs from that of *Pinaceae* and other genera of conifers widespread on the northern hemisphere.

The presence of *Cedroxylon* is, however, very probable, because the arrangement of the resin cysts in the wood perfectly agrees with that in recent *Cedrus*. Furthermore, also the occurrence of *Libocedrus*, *Cryptomeria*, *Cupressus* is very probable, particularly on the basis of the very low (2–5 cells high) rays.

The presence of *Sequoia* is natural. Not only from Europe but also from Asia and North America *Sequoia* remains were brought to light from this period. In our opinion some of these *Sequoia* remains may have belonged to *Metasequoia*, though only very slight anatomical and morphological differences testify to this. But our assumption is also supported by the Tertiary distribution of macrofossils determined as *Metasequoia*.

Notwithstanding, the stem structure of some of the fossils so fully agrees with that of the recent *Sequoiae* that the separation is very difficult. A number of stems of the *Sequoia* type offer evidence for the assumption that beginning with the Miocene probably several *Sequoia* or perhaps *Metasequoia* species must have lived in Europe, since it is not likely that 2–3 *Sequoia* species could have developed into such a great variety, not even if eventual changes of climatic and soil conditions are surmised, nor could such a variety of a similar histological structure have become manifest to such a remarkable extent. In spite of the high degree of anatomical differences we did not give every *Sequoia*-like stem a new specific name.

It is to be noted, however, that we found entirely *Metasequoia*-like stems in the environments of Sajókazinc and Karancskeszi, which indicates that this genus was widespread in the Helvetian of the present territory of Hungary. *Metasequoia* macrofossils are known from the Tertiary from several foreign sites, so it is by no means surprising that such stems were found also in Hungary. The same can be stated on *Cryptomeria*, *Cupressus* and *Libocedrus*, which genera must have lived next to each other in the Helvetian Hungary. The records anyway seem to verify that numerous representatives of the families *Pinaceae*, *Taxodiaceae* and *Cupressaceae* had lived in the European Helvetian already. At present, these families occupy vast territories of the northern hemisphere.

Broad-leafed trees. As has been mentioned, a considerable part of these must have lived at a time in tropical or subtropical environment. *Liquidambar* lives in the warm regions of North America, the Far East and Asia Minor. *Shorea*, as one of the representatives of *Dipterocarpaceae* can be found in the Sunda Islands. *Icacinaceae*, *Lauraceae* are also inhabitants of the tropical or subtropical regions. Part of the *Ilex* are natives of the tropical and subtropical regions of South and North America and the Far East, one species mainly of South Europe. Also the *Euphorbioxylon*s must have lived under a subtropical climate, since the recent *Euphorbiaceae* are also mostly indigenous in such regions.

The present forms of *Carya*, *Pterocarya* are inhabitants of the warm–temperate zones (see Map 7 on p. 80). The majority of the silicified woods originating from the Helvetian—on the grounds of their specific structure—must have lived only in such regions. Only 3 palm stems have been so far examined: *Palmoxylon hungaricum*, *Palmoxylon magyaricum* and *Palmoxylon lacunosum* var. *axoniense*. This does not mean that the palms widespread in the Burdigalian had altogether become extinct in the Helvetian; leaves or pollens of palms were repeatedly exposed from the later Tortonian and the Sarmatian. But none of the remains of the broad-leafed trees show a structure from which a widely changing temperature could be inferred, since *Quercus*, *Ulmus*, *Celtis*, *Zelkova*, *Pterocarya* and *Carya* occur also in the temperate and warm–temperate zones. The types recorded here, similarly to the Burdigalian, are rather suggestive of a warm subtropical climate. We must not forget either that temperature and the other climatological conditions do change in general not only horizontally but also vertically, and thus a mountainous region may favour some woody species perhaps under equable and mild conditions in the valleys, while others with higher situation under different circumstances.

The occurrence of some tropical genera in the Helvetian still deserves special attention.

Particular regard should be paid to *Lauraceae* and *Liquidambar*. Several species have been found and distinguished in both genera. *Lauraceae* remains were exposed at Szokolya, Mogyoród, Hidas and Zagyvapálfalva. *Lauraceae* were widespread in Hungary (Andreánszky 1955, Pálfalvy 1963). The great variety of their species points to a mild or subtropical climate.

We also succeeded in demonstrating a number of species of the genus *Liquidambar* from several sites. Separation of these has been carried out according to the tangential structure of the cross sections and the rays, depending on whether the rays are uni-, bi- or triseriate, and according to the number and width of the bars in the scalariform perforation of the tracheae. *Liquidambar* came to light from 4 sites of the Helvetian layers, namely from Szarvaskő, Szécsény, Nógrádszakál, and Kárász. *Liquidambar* was consequently rather widespread in Hungary in the Helvetian, under mild subtropical conditions. According to Mägdefrau, the *Liquidambar*s abounded in the Miocene not only in Hungary but also in the whole of Central Europe. The Helvetian stage is particularly rich in various *Icacinoxylon*s. However, some of the fossils determined as *Icacinoxylon* are perhaps *Magnolia* or *Platanus*, since these three genera are rather difficult to separate. If besides scalariform perforation also spiral thickenings occur, the fossil is to all probability *Icacinoxylon;* if spirals are absent, it still can be *Icacinoxylon* (or *Platanus* or *Magnolia*) because *Icacinaceae* exist also without spiral thickenings. However, the presence of the mucilaginous ducts in the broad rays permits inferring *Icacinaceae* primarily.

The *Shoreoxylon* of Budafok which belongs to *Dipterocarpaceae* is also indicative of a tropical and subtropical climate and as such well fits into the flora of the Helvetian stage. The area of its distribution is shown by Map 5 (on p. 54).

Special mention should be made of the stem of Mátranovák belonging to *Meliaceae*. As far as known to us, this family has not yet been demonstrated for Central Europe on the ground of fossil stems.

Of the *Juglandaceae*, we have established several genera: from Mátyásföld the species *Caryoxylon budense*, from Nemti an *Eucaryoxylon*, and a *Pterocaryoxylon* from Piliny. All three genera are inhabitants of warm-temperate and temperate regions. *Carya* is indigenous in North America and China, *Pterocarya* (see Map 7 on p. 80) in the Caucasus and Southeastern Asia, *Juglans* from Southern Europe through Asia Minor to Southeastern Asia, while in North America it lives in association with *Carya*, thus in an area corresponding more to the temperate climate. Their occurrence in the Helvetian only supports our opinion on the subtropical climate. It should be noted, however, that *Juglandaceae* lived not only in the Helvetian but also in the Tortonian and Sarmatian wherefrom stems as well as leaves and fruits have been brought to light.

Silicified woods of this stage have been examined from comparatively few sites. The fossils from Hidas and Herend–Szentgál were determined by Haraszty, those from Nagyréde and Jobbágyi by Greguss, the stems from Várpalota by Tuzson, Sárkány and Greguss. Most of these are conifers, broad-leafed trees and palms being scarce among them. The records of Várpalota deserve special interpretation.

Tuzson (1906) maintained that the lignites and silicified woods of Várpalota derived from *Cryptomeria japonica*. Sárkány (1943) established that "the coal layer of Várpalota is composed of carbonized stems of exclusively one species, the tertiary form of *Sequoia sempervirens*". Since he did not publish drawings, and the photos are not convincing either, his statements cannot be accepted, particularly inasmuch as he originates the lignite of Várpalota from one species only. Neither is the statement of Tuzson justified, according to whom the brown coal of Várpalota primarily consists of *Cryptomeria japonica* stems.

We have repeatedly tackled the question whether the Lower Tortonian silicified and carbonized stems of Várpalota received for examination from Prof. Vadász originate from mixed forests of broad-leafed and coniferous trees, or from a uniform mass of conifers. Our examinations revealed that mainly *Sequoia* species lived in the surroundings of Várpalota in the period under discussion, and these might have been of different requirements for habitat.

Among the samples examined, some of which originate from the surface mine of Cser while the rest from 15 different sites of the mine of Várpalota, there occurred no *Taxodium* which prefers marshland, but *Sequoia*, *Thuja*, *Metasequoia* did mainly occur indicating drier habitats. Consequently, in the Tortonian conifers of drier soil requirements dominated rather than *Taxodiums*, although the hydrophyte *Glyptostrobus* may have abounded in the association. Since *Sequoia*-like wood remains are usually referred to as *Taxodioxylon*, though anatomically these definitely differ from *Taxodium*, we use the terms as synonyms.

Recent coal-petrographical examinations demonstrated broad-leafed trees in the material of the lignite of Várpalota.

As to the other Tortonian records, *Taxodioxylon*, *Glyptostroboxylon* and *Sequoioxylon* from Hidas have been determined by Haraszty; the Várpalota fossils by Sárkány; *Taxidioxylon taxodii*, *Taxodioxylon gypsaceum*,

Map 16. Fossil stems from the Tortonian

Szentgál (1), Hidas (2), Jobbágyi (3), Nagyréde (4), Szurdokpüspöki (5), Várpalota (6)

Cupressinoxylon, *Betuloxylon* and *Palmoxylon* from Herend–Szentgál again by Haraszty.

Also a warm but somewhat drier climate is indicated by the *Albizzioxylon hungaricum* of Szurdokpüspöki, which is highly suggestive of, or almost identical with, the *Acacinoxylon indicum* described by Ramanujam, and perfectly fits into the xerothermous Tortonian flora.

(d) Sarmatian

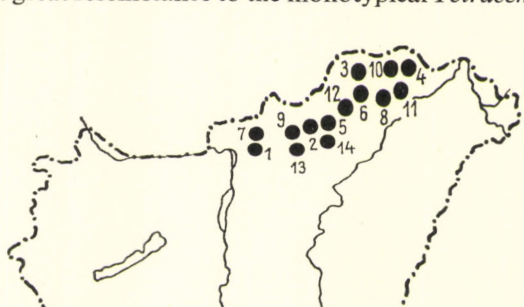
As appears from Map 17, silicified pieces of Sarmatian stems are known from a number of sites in Hungary so from Buják, Erdőbénye, Egerszalók, Füzérkomlós, Sámsonháza, Füzérkajata, Mikófalva, Miskolc-Tapolca, Rátka, Sály, Sóshartyán, Szilvásvárad and Tokaj. Some of these stems bear traces of burning or calcining. Anyway, a rather wide variety as to families, genera and species has been established. The fossils of Füzérkomlós and Tokaj described by Greguss, those of Mikófalva determined and described by Andreánszky, the well-preserved record of Telkibánya determined by Andreánszky and described by V. Széky-Fuchs testify to this.

Of the conifers, two *Taxodioxylon*s, one *Cedroxylon*, a *Pinuxylon*, a *Laricioxylon* and perhaps a *Taxus* could be identified.

From among the broad-leafed trees three *Populoxylon*s, three *Fraxinoxylon*s, one *Dillenioxylon*, a *Liquidambaroxylon*, *Celtixylon*, *Quercoxylon*, *Aceroxylon*, *Platanoxylon*, *Carpinoxylon*, *Pterocaryoxylon*, *Ilicoxylon*, *Vitioxylon* and a homoxylous tree, *Tetracentronites* were brought to light.

Particularly interesting is the presence of *Tetracentronites hungaricum* in the Sarmatian of Tokaj. This record of high importance (detailed on p. 128) bears a great resemblance to the monotypical *Tetracentronites* of China, the distribution of which is restricted even in that country to a very narrow temperate though fairly subtropical area. As a tree of such nature it fits well into the Sarmatian flora of Central Europe.

The appearance of *Dillenioxylon* unknown so far in Hungary is very important in the Sarmatian flora. According to Metcalfe and Chalk, *Dilleniaceae* belong, after *Ranunculaceae*, to the most primitive woody plants. They (320 known species) are mainly natives of the tropical and subtropical regions. Most widespread in



Map 17. Fossil stems from the Sarmatian

Buják (1), Egerszalók (2), Erdőbénye (3), Füzérkomlós (4), Mikófalva (5), Miskolc-Tapolca (6), Nógrádszakál (7), Rátka (8), Sály (9), Telkibánya (10), Tokaj (11), Sámsonháza (12), Sóshartyán (13), Szilvásvárad (14

Australia, they are mainly members of the scrub vegetation. They are trees, shrubs and lianas.

The *Populus* species of Mikófalva indicate more temperate and extreme climatological conditions. Andreánszky mentions a new *Populus* leaf which he relates with *Populus acuminata.* Judged by the cross-section photographs, one of the fossil stems of Mikófalva is suggestive of *Populus tremula.*

The cross-section structure of another *Populus* stem from the Sarmatian of Mikófalva is more suggestive of *Populus alba* since both in this recent species and in the Sarmatian fossil the paired pores and the short multiples of three or four members are rather frequent. Among the stems of both Füzérkomlós and Mikófalva *Fraxinoxylon*s have been found. Most of the pieces belong to the *Sequoioxylon* species, more exactly to *Taxodioxylon sequoianum* or *Taxodioxylon gypsaceum*, as demonstrated by Andreánszky (1951b) from Mikófalva. The majority of the cross slides of the Sarmatian woods show no conspicuous annual ring boundaries, which permits a uniformly warm temperate to subtropical climate. Such diffuse-porous woods were the fossils determined as *Ilicoxylon, Carpinoxylon, Pterocaryoxylon.* On the other hand, definite annual ring boundaries could be established in *Fraxinus* and *Celtixylon*, as well as in the conifers *Pinuxylon, Taxodioxylon* and *Cedroxylon.* However, none of the forms examined could be regarded as microthermous. While in the Helvetian–Tortonian stage xerophilous tropical or subtropical elements predominated, from the Sarmatian, along with subtropical elements, such remains of plants have been exposed which prefer temperate climate.

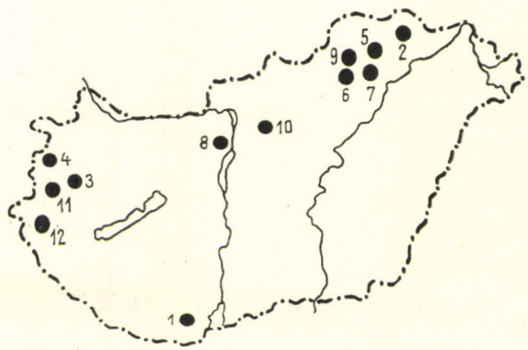
It should be stressed repeatedly that not all fossils coming to light from Sarmatian layers had lived necessarily in the Sarmatian stage; forms of the preceding Tortonian–Helvetian may have freely got into the Sarmatian layers. However, leaf imprints of the genera to which most of the stem remains belong have already been well demonstrated from the Sarmatian, as evidenced by the Sarmatian monograph of Andreánszky (1959). By xylotomical examinations no more than the synchronous occurrence of leaf imprints and silicified woods can be documented.

PLIOCENE

Pannonian

Silicified woods of the Pliocene, more exactly of the Lower and Upper Pannonian, also came to light from several sites (Map 18). According to our present knowledge, the woody plants so far exposed from the Pannonian layers exhibit by and large the same generic features as those that came to light from the Sarmatian.

Of the conifers: *Taxodioxylon sequoianum, Glyptostroboxylon, Pinuxylon, Laricioxylon, Cupressinoxylon*, and a questionable *Taxus*, while of the broadleafed trees: *Pterocaryoxylon, Liquidambaroxylon, Quercoxylon, Fagoxylon,*



Map 18. Fossil stems from the Pannonian

Danicpuszta (1), Fóny (2), Kemenesmagasi (3), Kőszeg-Pogányvölgy (4), Megyaszó (5), Nagyvölgy (6), Petőfibánya (7), Pestszentlőrinc (8), Rudabánya (9), Selyp (10), Szombathely (11), Szombathely-Vashegy (12)

Fraxinoxylon, *Vitioxylon*, furthermore *Acer*, *Ulmus*, *Zelkova* (?), *Celtis*, *Betula*, *Populus* stem pieces have been recorded. Of these, *Acer* is perhaps the only insect-pollinated plant, while the others (*Pterocarya*, *Tilia*, *Liquidambar*, *Fagus*, *Fraxinus*, *Zelkova* and *Quercus*) are pollinated by the wind.

The Pliocene forms show no definite tropical or subtropical character. Their nearest extant relatives live under temperate climate: *Quercus*, *Fraxinus*, *Fagus* in Europe; *Zelkova* in the Far East and in Western Asia; *Liquidambar* in Asia Minor, in the Far East and in North America; *Pterocarya* in the Far East and in Western Asia. *Glyptostrobus* in the Far East; while *Sequoioxylon*s or *Taxodioxylon taxodii* and their nearest relatives in North America.

TABLE I

TIME AND STRATIGRAPHICAL DISTRIBUTION OF THE PLANT REMAINS

Era	*Period*	*Stage*	*Coniferae*	*Palmae*	*Dicotyledones*	*Total*	*Climate*
Quaternary	Pleistocene		—	—	4	**4**	
Tertiary	Pliocene	Pannonian	14	1	18	**33**	Hardly warmer than the present, somewhat subtropical, at the limit of temperate
	Miocene	Sarmatian	7	1	30	**38**	Medium wet, subtropical
		Tortonian	22	2	3	**27**	Dry, warm, subtropical
		Helvetian	33	3	63	99	Warm, subtropical
		Burdigalian	10	1	10	**21**	At the limit of the torrid zone, subtropical, equable monsoon climate
	Oligocene		6	1	15	**22**	Tropical
	Eocene		2	—	2	**4**	
Mezozoic	Cretaceous		15	—	—	**15**	Warm, dry
	Liassic-Bath		14	—	—	**14**	Warm, dry, at places torrid
Palaeozoic	Permian		17	—	—	**17**	Warm, dry
Total number of the pieces of stem examined:			140	9	145	294	

A survey of localities and the ages shows that the silicified woods mainly originate from the Hungarian Central Mountains, and, to a lesser extent, from the Mecsek and Tokaj mountains. Of the 294 stem remains exposed from about 150 sites, 221 samples were elaborated by the author and 73 by other Hungarian and foreign authors during the past hundred years.

As a final result, we table here the main types of the stems examined according to geological ages, and our conclusions on the climatic conditions that prevailed in the territory of Hungary from the Permian. Needless to say, we regard these conclusions as approximately correct only, and it follows from the topical aspects that further investigations based on more abundant material than have been available to us will modify or rectify our statements.

TABLE II

OCCURRENCE OF FOSSIL TREES, IMPRINTS AND

			Gymnospermae																									
Time scale			Baieroxylon	Ginkgoxylon	Agathoxylon	Araucarioxylon	Brachyoxylon	Dadoxylon	Ulmannites	Dacrydioxylon	Podocarpoxylon	Taxus	Torreyoxylon	Callitroxylon	Cupressinoxylon	Libocedroxylon	Platyspiroxylon	Widdringtonioxylon	Cryptomerioxylon	Glyptostroboxylon	Metasequoioxylon	Sciadopityoxylon	Sequoioxylon	Taxodioxylon	Cedroxylon	Keteleeria	Laricioxylon	Pinuxylon
Caenozoic	Quaternary																		■									
	Pliocene			■▲+											■+					■▲+++		■+	■	++++++▲+■	■	■	■	■●▲
	Miocene	Sarmatian		▲								▲	▲		■▲	▲●				▲		■		■▲+	■		●	■▲+
		Tortonian		+											++					●●●+			●●●●●●●●●●●●●+	+■+●+++	■			■▲
		Helvetian		■							■●				●●●●●●+	▲		●●	●	▲	●●	■	●●●●●●●●●●●●▲+	+■++●+▲	■▲●	■▲	■▲●	■●▲
		Burdigalian								■	■▲	+				▲				▲		■	●●▲			■●		●●●●●■▲
		Aquitanian																										
	Oligocene			+						●●	■▲●					▲				▲			●▲+	■	■	■		■▲
	Eocene			■							■+												▲	■				
Mesozoic	Cretaceous		■		●	●●●●●●■		●●●			●●●●●●●■		●											■				
	Jurassic		■		●●	●●●●●●●	●●				■			●			●							■				
	Triassic																											
Palaeozoic	Permian		▲●●	●		●●●●●●		●●	++++▲								●●●+											
Total			5	9	3	18	2	5	5	3	18	2	2	1	13	5	5	2	2	13	2	5	33	27	7	6	5	21

● Elaborated by the author + Elaborated by other authors ■ Pollen (after Kedves) ▲ Imprint (after Pálfalvy)

It is an interesting observation that not a single broad-leafed tree has been brought to light so far either from the Palaeozoic, i.e. from the Permian, or the Mesozoic, i.e. from the Liassic and Cretaceous. This, however, implies in no way that no mono- and dicotyledonous broad-leafed trees could have existed in the territory of Hungary in the Mesozoic. Imprints

Angiospermae																																		
Palmoxylon	Tetracentronites	Dillenioxylon	Cinnamomoxylon	Laurinoxylon	Myristicoxylon	Liquidambaroxylon	Platanoxylon	Malus	Acacioxylon	Shoreoxylon	Tilia	Nyssoxylon?	Sterculioxylon	Aceroxylon	Ilicoxylon	Vitioxylon	Citronella	Icacinoxylon	Alnus	Betuloxylon	Carpinoxylon	Fagoxylon	Quercoxylon	Pterocarioxylon	Populoxylon	Celtixylon	Ulmoxylon	Zelkoxylon	Ficoxylon	Euphorbioxylon	Laticiferoxylon	Ebenoxylon	Fraxinoxylon	Total
																			■●				●										●	5
■+			▲	■▲		■▲++	■▲	+		●	■▲	■	■	▲	■				■▲	■++	■▲	■▲+	●■▲+++	■▲+	+		■▲+	■▲					++	73
■▲	●		▲	▲		■▲	▲+				▲	■		▲●+	■▲	▲●		●●	■▲	■▲	■▲●	■▲	▲■+++	■▲●	■▲+●●	●▲	■▲	■▲				■▲	●▲++	71
++			▲	●▲		■+			▲			■		▲	■					■+	■		■▲	■+	■	▲	■▲	■▲				■▲●		56
■●●+▲		●▲	●●●▲	●●●●▲		■▲●●●●●●●	■▲+		●	●	■▲	■	▲	▲	■●▲	▲		●●●●●●●●●●●●●●●	■▲	■▲	■▲	■▲	■▲●●	●●●■●▲	■▲	▲+	■▲●●	■▲	▲●	●	●	■▲	■	139
■●▲			▲	●▲●●		■					■	■	▲	▲	■▲		●	●●	■▲	■	■●▲	■▲	■▲++	■▲	■		■▲	■▲	▲			■▲	■	61
■●▲			▲●	▲	●●	■					■	■	▲●	▲	■			●●●●●●	■	■	■▲		■▲●	■			■▲		▲		●	■●●		52
■▲			▲	▲			■			●	■	■●	■▲		■▲	■		■	■		■		■▲	■▲	▲		■		▲	■				30
																																		21
																																		15
																																		21
19	1	2	11	16	2	18	8	1	2	3	8	8	7	8	12	4	1	28	12	11	14	9	27	20	11	5	17	10	5	2	2	12	9	544

of pollens, leaves and fruits originating from such trees are known, although in a low number, to have come up from these ages.

From the Eocene the number of broad-leafed trees is rising while the conifers of araucaroid pitting are displaced by the conifers of modern pit system, with and without resin ducts.

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SUBJECT INDEX

LEGENDS TO THE PLATES

The measurement data of the photos refer to magnifications higher by some 15 per cent than were available within the scope of this volume and should be considered accordingly (e.g. 85 instead of 100).

Figs of Plate I.

1–9. *Palmoxylon dorogense* n. sp. (Dorog, Oligocene).
1. *C.* Vascular bundles in the ground tissue (30×) — 2. *C.* A solitary vascular bundle (100×) — 3. *C.* Detail of the ground tissue (100×) — 4. *T.* The scalariform thickenings of the vessels (200×) — 5. *T.* Magnified picture of a stegma (600×) — 6. *T.* In the ground tissue sclerenchyma bundles (200×) — 7. *T.* Scalariform perforation of two vessels (200×) — 8. *T.* Scalariform thickening of two vessels (200×) — 9. *T.* Detail of Fig. 8 (600×).

Figs of Plate II.

1–6. *Palmoxylon sabaloides* Greguss (Ipolytarnóc, Burdigalian).
1. *C.* In the ground tissue the dispersed vascular bundles are arranged parallel to the periphery — 2. *C.* Two vascular bundles. The sclerenchyma bundle surrounds the vascular bundle — 3. *C.* Solitary vascular bundle. Above the xylem part in the middle the phloem part — 4. *C.* Fig. 2. magnified — 5. *C.* Detail of xylem magnified — 6. *C.* Detail of a xylem bundle (200×).

Figs of Plate III.

7–11. *Palmoxylon sabaloides* Greguss (Ipolytarnóc, Burdigalian).
7. *C.* A xylem bundle, strongly magnified detail of Fig. 8 (350×) — 8. *C.* Structure of a vascular bundle (100×) — 9. *C.* Two vascular bundles of the *Sabal palmetto*. Structure coincides with the vascular bundle in Fig. 8 (100×) — 10. *R.* On the left side (a) step-like thickening of tracheae, on the right side (b) above, cross section of scalariform perforation (200×) — 11. *R.* Longitudinal section of sclerenchyma bundle, around ground tissue (30×).

Figs of Plate IV.

1–6. *Palmoxylon hungaricum* Greguss (Salgótarján, Helvetian).
1. *C.* Xylem and phloem detail of vascular bundle. On the site of the phloem part: cavity. On both sides the step-like thickened trachea (300×) — 2. *C.* The same, the cells of the ground tissue are of different shape, elongated (300×) — 3. *C.* In the ground tissue the vascular fibre bundles and the fibre bundles are scattered (10×) — 4. *C.* A vascular fibre bundle (100×) — 5. *C.* In the ground tissue 3 fibre bundles. The cells of the ground tissue are loosely attached to each other (100×) — 6. *C.* Fibre bundle detail of a vascular fibre bundle (100×).

Figs of Plate V.

7–10. *Palmoxylon hungaricum* Greguss (Salgótarján, Helvetian).
7. *C.* The elongated cells of the ground tissue, perpendicular to the fibre bundle. On the fibre bundles circular stegma (300×) — 8. *C.* Spiral and annular thickenings of the tracheae

(300×) — 9. *C.* Longitudinal structure of the fibre bundle (300×). On the right side row of stegmata — 10. *C.* Longitudinal structure of xylem bundle. In the vessels annular thickenings, between the vessels thin-walled parenchyma cells (300×).

Figs of Plate VI.

1–9. *Palmoxylon lacunosum* var. *axoniense* Watelet (Diósjenő, Helvetian).
1. *C.* The site of the sclerenchyma bundle of the vascular bundles is occupied by lumina which are mostly reniform. The ground substance is parenchyma (4×) — 2. *C.* Detail of Fig. 1. Below the reniform cavity collateral vascular bundle. Around, more or less isodiametric parenchyma cells (15×) — 3. *C.* Vascular bundle residues from beside the sclerenchyma bundle (50×) — 4. *T.* Isodiametric ground tissue parenchyma cells of different shape (10×) — 5. *T.* The same. On the lower part in the ground tissue thick-walled idioblast with narrow cavity — 6. *T.* Longitudinal slide of vascular bundle or sclerenchyma fibre, respectively. Beside the ground tissue, parenchyma cells perpendicular to the longitudinal axis (100×) — 7. *T.* Ground tissue parenchyma (50×) — 8. *C.* Sclerenchyma bundle in front of a vascular bundle (100×) — 9. *R.* Ringform thickenings in a vessel (200×).

Figs of Plate VII.

1 and 2. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian).
1. *C.* Blurred annual ring border, xylem perfectly homogeneous, without vessels. At some places rubber tube (2 1/4×) — 2. *C.* The same. On the left side a dark oblique line, probably aggregate ray (9×).

Figs of Plate VIII.

3–10. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian).
3. *C.* Detail of the xylem. The cross sections of the tracheids are of equal size, attached to each other in both longitudinal and horizontal rows. In some of them, the walls are thick, in others thin, the latter being probably parenchyma cells. In the lower part of the picture a detail of *Sahnioxylon raimahalense* (in white frame), same magnification. The two cross-section structures are very similar (100×) — 4. *C.* Detail from the xylem. The arrangement of the tracheids is suggestive of *Conifers* (200×) — 5. *C.* Two resin or rubber tubes in the xylem. The content of the right-side duct is of golden yellow colour. A more developed right-side duct (100×) — 6. *C.* Among the thick-walled tracheids sporadically thin-walled parenchyma cells (200×) — 7. *T.* 20 cell high ray. The cross sections of the ray cells are squares or upright oblongs (100×) — 8. *T.* Detail of ray. Thick cell wall, narrow lumen (300×) — 9. *T.* 3 cell layer wide ray (100×)— 10. *T.* 1–2 cell layer wide ray (100×).

Figs of Plate IX.

11–20. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian).
11. *R.* Ray structure, the ray cells are squares or upright oblongs. Somewhat heterogeneous structure (100×) — 12. *R.* A detail of the previous picture, higher magnification (200×) — 13. *R.* In the walls of the ray cells in a cross field 8–12 tiny pits (see the arrow) (200×) — 14. *R.* The tracheid walls are thick, in their sinuous lumen rubber-like content. The primary lamellae are marked with a black line (300×) — 15. *R.* The radial walls of the tracheids are densely covered with tiny bordered pits (300×) — 16. *R.* The same. The picture within the white frame in Fig. 8 represents *Sahnioxylon;* the identical structure is very conspicuous

(300×) — 17. *R*. In the tracheid walls the tiny bordered pits are sometimes arranged loosely beside each other, similarly as in *Homoxylon rajmahalense* (left side drawing) (300×) — 18. *R*. Structure of rubber duct; the original content is golden yellow (200×) — 19 and 20. *R*. In the walls of the spring tracheids scalariform thickening. The right side of Fig. 20 represents *Sahnioxylon rajmahalense*, the similarity, almost identity of the two is conspicuous (300×).

Figs of Plate X.

1–9. *Flacourtioxylon* sp.? (*Nyssoxylon?*) (Tatabánya, Middle Eocene).
1. *C*. In the ground substance dispersed solitary or paired pores (100×) — 2. *T*. The rays are 3–4 cells wide, on their upper border at a height of several cells uniseriate (110×) — 3. *T*. The same (300×) — 4. *T*. The interior of the vessels with wide lumina is filled with a dark content. At the lower arrow spiral thickening of the neighbouring vessel, at the upper arrow calcium oxalate crystals (300×) — 5 and 6. *T*. Next to the vessels rows of parenchyma cells (300×) — 7. *T*. At the arrow many tiny bordered pits in the wall of the vessel (300×)— 8. *R*. At the arrow several tiny upright elliptic pits in the ray cell (300×) — 9. At the arrow heterogeneous ray structure.

Figs of Plate XI.

1–10. *Dillenioxylon mikófalvense* n. gen. et n.sp. (Mikófalva, Sarmatian).
1. *C*. Annual ring boundary blurred, a diffuse-porous wood, the tracheae are solitary or paired. 1–2 and 6–8 seriate rays (30×) — 2. *C*. The same. The apotracheal parenchyma bands do not touch the neighbouring rays (100×) — 3. *C*. The same (200×) — 4. *T*. 1–(2) and more seriate rays (30×) — 5. *T*. The same. In the broad ray horizontal ducts (100×) — 6. *T*. Broad aggregate ray (300×) — 7. *R*. Procumbent rays, below reticular perforation (200×) — 7a. *R*. In the wall of the trachea gradual transition of the opposed pits (200×) — 8. *R*. 2 scalariform perforations (300×) — 9. *R*. Member of a vessel, in its wall loose bordered pits, their aperture horizontal (300×) — 10. *R*. In the walls of the vessels the simple pits are attached to each other opposedly (300×).

Figs of Plate XII.

1–8. *Laurinoxylon vadászi* Greguss (Hidas, Helvetian).
1. *C*. Ground substance xylem fibre and fibre tracheid. Solitary or paired vessels or multiples of three members. 3–8 seriate rays (50×) — 2. *C*. 8–10 seriate rays (100×) — 3. *C*. Pore ray with three members. 7 seriate ray (100×) — 4. *T*. 2–4 seriate rays. Some rays are bordered by oil cells (100×) — 5. *T*. On the margins of 3–4 seriate rays oil cells (150×) — 6. *T*. The same (150×) — 7. *R*. In the vessels tyloses. Procumbent ray cells (100×) — 8. *R*. Procumbent ray cells, on the rays oval and elliptic large oil cells (200×).

Figs of Plate XIII.

1–9. *Laurinoxylon* cf. *hasenbergense* Süss (Salgótarján, Helvetian).
1. *C*. No annual ring boundary, in the ground substance solitary or paired pores (100×) — 2. *C*. Detail of Fig. 1. Ground substance xylem fibre (100×) — 3. *C*. A paired pore surrounded by vasicentric wood parenchyma (200×) — 4. *T*. Triseriate ray, beside wood fibre and wood parenchyma, on the right side the surface of the vessel is covered by dense pits (100×) — 5. *T*. Triseriate ray, beside wood parenchyma, on the right side the surface of the

vessel is densely covered by pits (100×) — 6. *T.* Triseriate ray, on the top a conic oil cell (200×) — 7. *R.* Ray structure, in the middle a crystal in the oil cell (200×) — 8. *R.* Radial slide seen laterally. The pitting of a trachea (300×) — 9. *R.* At the edge of the heterogeneous ray rounded-off oil cells, in one of them a crystal (200×).

Figs of Plate XIV.

1–3. *Laurinoxylon aniboides* Greguss em. Süss (Ipolytarnóc, Burdigalian).
4–9. *Laurinoxylon müller-stollii* Greguss em. Süss (Ipolytarnóc, Burdigalian).
1. *C.* In the ground substance solitary and paired pores (100×) — 2. *T.* Uni- and biseriate rays, in the ground substance elongated oil cells (100×) — 3. *R.* Heterogeneous ray skeleton, at the margin of the rays conic oil cells (100×) — 4. *C.* In the ground substance solitary and paired pores (100×) — 5. *T.* Uni- and biseriate rays. In the vessels tyloses — 6. *T.* Biseriate rays, at their margins oil cells (150×) — 7. *R.* Heterogeneous ray structure, in the tracheae tyloses (150×) — 8. *R.* The walls of the vessel are densely covered by bordered pits (150×) — 9. *R.* The walls of the vessel are densely covered by bordered pits, the apertures of which are slit-like (300×).

Figs of Plate XV.

1–8. *Laurinoxylon* cf. *californicum* (Platen) Süss (Zagyvapálfalva, Lower Helvetian).
1. *C.* In the ground substance solitary or paired vessels (100×) — 2. *C.* In the ground substance solitary and paired pores (200×) — 3. *T.* 2–3 seriate rays closely beside each other (100×) — 4. *T.* 2–3 seriate rays, on the top of some of them oil cells (200×) — 5. *T.* 3–4 seriate rays, on both ends of one of them oil cells (200×) — 6. *R.* Horizontally elongated ray cells, on the left side retort-shaped oil cell (200×) — 7. a, b and c: *R.* Thick-walled emerging oil cells of considerable diameters (300×) — 8. *R.* The trachea walls are densely covered by bordered pits, their aperture is horizontal, those of the pits situated one next to the other all in one line (see below) (300×).

Figs of Plate XVI.

1–9. *Laurinoxylon pálfalvyi* n. sp. (Becske, Burdigalian).
1. *C.* Annual ring boundary blurred. Between the xylem fibres solitary tracheae (10×) — 2. *C.* Detail of Fig. 1 magnified. Paired pores or short multiples (30×) — 3. *C.* Xylem fibre ground substance (200×) — 4. *C.* Probably longitudinal rubber duct (150×) — 5. *T.* 2–3 seriate rays (50×) — 6. *T.* Pith ray cells 1–3 seriate rays, in the interior of the cells a dark content (100×) — 7. *T.* Biseriate rays (200×) — 8. *R.* The surface of the vessels is covered by dense bordered pits which are almost horizontally aligned beside each other (200×) — 9. *R.* On the right side in the trachea scalariform perforation (100×).

Figs of Plate XVII.

1–11. *Laurinoxylon daberi* n. sp. (Jobbágyi, Tortonian).
1. *C.* A diffuse-porous wood, in the ground substance of the xylem fibre solitary vessels, short multiples with 2–3–5 members (30×) — 2. *C.* The same (50×) — 3. *C.* Around the vessels vasicentric parenchyma, triseriate ray, in the vessels tyloses (100×) — 4. *C.* 2–3 seriate heterogeneous ray (100×) — 5. *C.* The same (200×) — 6. *C.* In the walls of the vessels bordered pits are alternating, the aperture is a horizontal slit (200×) — 7. *R.* In the ground substance longitudinal parenchyma cells, in some of them a calcium oxalate crystal

(200×) — 8. *R.* In the radial walls of the ray cells circular and elliptic simple pits (300×) — 9. *R.* The same (300×). Detail of *Laurinoxylon hasenbergense* (300×) — 10. *R.* In the radial wall of the ray cell 6–10 simple pits (100×) — 11. *R.* In the radial wall of the ray cell several tiny pits (see the arrow) (300×).

Figs of Plate XVIII.

1–7. *Laurinoxylon süssi* n. sp. (Szokolya, Helvetian).
8 and 9. *?Cinnamomoxylon* sp. (No. 2) (Mogyoród, Helvetian).
1. *C.* A diffuse-porous wood, in the xylem ground substance solitary or paired vessels or multiples (100×) — 2. *C.* The same (100×) — 3. *C.* Paired pores surrounded by vasicentric parenchyma (200×) — 4. *T.* The rays are 2–3 cells wide, on both sides bordered by oil cells (100×) — 5. *T.* The rays are 2–3 cells wide (100×) — 6. *R.* At the edges of the rays conic oil cells (200×) — 7. *R.* The tracheid walls are covered by tiny bordered pits (300×) — 8. *T.* 2–3 seriate and 40 cell high rays, on the top of the left side ray an oil cell (200×) — 9. *R.* Detail of ray. Beside a conic oil cell (300×).

Figs of Plate XIX.

1–9. *?Laurinoxylon* sp. (Apátvarasd, Helvetian).
1. *C.* A diffuse-porous wood, in the homogeneous xylem fibre ground substance the vessels are solitary, paired or short multiples, in the tracheae a dark content. The rays are 2–3-seriate (50×) — 2. *C.* Detail of Fig. 1 (100×) — 3. *C.* Solitary pore pair and multiple of three, the ground substance is xylem fibre (100×) — 4. *T.* The rays are 1–4 cells wide and 1–20 cells high (100×) — 5. *T.* Biseriate heterogeneous ray (200×) — 6. *T.* Biseriate ray, at the margin oil cell (200×) — 7. *R.* In the wall of the vessel tiny bordered pits (300×) — 8. *R.* Heterogeneous ray structure (300×) — 9. *R.* At the edge of the heterogeneous ray low oil cell (300×).

Figs of Plate XX.

1–4. *?Cinnamomoxylon* sp. (No. 1) (Dorog, Oligocene).
1. Annual ring boundary blurred. Solitary and paired pores (100×) — 2. *T.* Bi- and triseriate rays, at their margins, oil cells (200×) — 3. *T.* Magnified structure of a ray, on both sides oil cells (300×) — 4. *R.* At the margin of the ray oval oil cell (300×).

Figs of Plate XXI.

1–6. *?Cinnamomoxylon* sp. (No. 3) (Cserháthaláp, Helvetian).
7–9. *?Cinnamomoxylon* sp. (No. 4) (Budaörs, Helvetian).
1. *C.* No annual rings in the ground substance, the vessels are solitary or paired (50×) — 2. *T.* At the margins of the bi- and triseriate rays elongated oil cells (100×) — 3. *R.* In the longitudinal tracheae tyloses, in the right side vessel scalariform perforation (200×) — 4. *T.* Bi- and triseriate pith rays, between them horizontally running ducts (50×) — 5. *T.* At the margins of bi- and triseriate rays elongated oil cells (200×) — 6. *T.* Between two horizontal ducts biseriate ray, at its margin elongated oil cell (200×) — 7. *C.* 1–2 seriate rays, in the ground substance solitary parenchyma cells (30×) — 8. *T.* 1–2 seriate heterogeneous rays. On the right side oil cells (200×) — 9. *T.* 2–3 seriate heterogeneous rays, in the border parenchyma oil content (300×).

Figs of Plate XXII.

1–9. *Myristicoxylon hungaricum* n. sp. (Budakalász, Lower Oligocene).

1. *C.* In the ground tissue solitary tracheae, terminal parenchyma, beside the vessels aliform parenchyma (50×) — 2. *C.* Terminal parenchyma (100×) — 3. *T.* Aggregate ray (100×) — 4. *T.* 1–2 seriate rays (100×) — 5. *T.* Simple and aggregate ray (100×) — 6. *R.* In the tracheae circular bordered pits arranged loosely in parallel rows — 7. *R.* Bordered pits situated at the endings of the tracheae (200×) — 8. *R.* Tyloses in the vessel (300×) — 9. *R.* In the radial wall of the rays large elliptic pits. Such pits occur in *Lauraceae* and *Myristicaceae* (300×).

Figs of Plate XXIII.

1–9. *Myristicoxylon bajnaense* n. sp. (Bajna, Oligocene).

1. *C.* Homogeneous annual ring field, the cross sections of the vessels (tracheids) rounded off (50×) — 2. *C.* At some places of the annual rings the larger lumina are cross sections of either vessels or ducts (100×) — 3. *C.* On the annual ring boundary the larger lumina are cross sections of either ducts or vessels (100×) — 4. *T.* The rays are 1–3 seriate and 10–15 cells high (50×) — 5. *R.* In the tracheid walls the bordered pits are arranged in one or two longitudinal rows (100×) — 6. *R.* In the walls of tracheids (vessels) the circular bordered pits are aligned by pairs in two rows (200×) — 7. *C.* On the cross section two longitudinal ducts (200×) — 8. *R.* In the radial wall of the ray cells pits of upright ellipses are seen, sometimes two pits above each other (300×) — 9. *R.* The same as Fig. 8.

Figs of Plate XXIV.

1–9. *Liquidambaroxylon weylandi* n. sp. (Szécsény, Helvetian).

1. *C.* A diffuse-porous wood, annual ring boundary hardly conspicuous, the vessels arranged in more or less radial rows — 2. *C.* The same (100×) — 3. *C.* The same (200×) — 4. *T.* The rays are 1–2 seriate and 30 cells high (100×) — 5. *T.* Ray skeleton (200×) — 6. *R.* The scalariform perforations are arranged at the same height (200×) — 7. *R.* Scalariform perforation (300×) — 8. *R.* In the walls of the vessels the pits are opposed (300×) — 9. *R.* In the ray cells rounded off resin-like grains (300×).

Figs of Plate XXV.

1–9. *Liquidambaroxylon horváthi* n. sp. (Kárász, Helvetian).

1. *C.* In the ground tissue of the xylem the solitary vessels are uniformly dispersed (50×) — 2. *C.* The same (100×) — 3. *C.* The same. The cross sections of the vessels are more or less angular (200×) — 4. *T.* The rays are 1–3 seriate (100×) — 5. *T.* 2–3 seriate ray (200×) — 6. *R.* In the walls of the vessels the bordered pits are arranged loosely in longitudinal paired rows (200×) — 7. *R.* Ray structure, in the radial wall simple round pits (200×) — 8. *R.* Scalariform perforation. In the radial wall the bordered pits are opposed (250×) — 9. *R.* Scalariform perforation, the number of the bars is 20 (250×).

Figs of Plate XXVI.

1–9. *Liquidambaroxylon kräuseli* n. sp. (Nógrádszakál, Sarmatian).

1. *C.* Uniformly dispersed pores, the ground substance consists of fibre tracheids (50×) — 2. *C.* The same (100×) — 3. *C.* The same (200×) — 4. *T.* The rays are 1–3 seriate, 1–20

cells high, of heterogeneous structure (100×) — 5. *T.* The same, the heterogeneous ray structure clearly appears (200×) — 6. *R.* Heterogeneous ray structure. In the longitudinal parenchyma cell the simple pits are arranged in one row (200×) — 7. *R.* Scalariform perforation, the bars are loose, one of them is furcately branching (300×) — 8. The arrangement of the simple pits in the walls of the fibre tracheids (300×) — 9. Heterogeneous ray structure (300×).

Figs of Plate XXVII.

1–9. *Liquidambaroxylon mägdefraui* n. sp. (Szarvaskő, Helvetian).
1. *C.* Uniformly dispersed pores in the wood. Ground substance xylem fibre (30×) — 2. *C.* The cross sections of the vessels are angular or radially elongated short ellipses. The ground substance is xylem fibre (100×) — 3. *T.* The rays are 1–30 cells high; for the most part uniseriate (50×) — 4. *T.* Uniseriate high rays (100×) — 5. *R.* The perforations are at the same height (100×) — 6. *R.* Two scalariform perforations. The number of the bars is 30 (200×) — 7. *R.* The same (300×) — 8. *R.* Complete scalariform perforation (300×) — 9. *R.* Ray structure, in the cross fields (lower left corner) circle-, ellipse- or stick-shaped pits (300×).

Figs of Plate XXVIII.

1–9. *Liquidambaroxylon* cf. *speciosum* Félix (Nagyvisnyó, Helvetian).
1. *C.* No noticeable annual ring boundary, in the ground substance the vessels are solitary. Narrow rays (50×) — 2. *C.* The same (100×) — 3. *C.* The same. The cross sections of the vessels are angular or rounded off (200×) — 4. *T.* 1–2 seriate rays (100×) — 5. *T.* The same (150×) — 6. *R.* In the walls of the vessels the bordered pits are opposed and very often arranged in vertical rows (200×) — 7. *R.* Heterogeneous ray structure. In the tracheids the pits are opposed and horizontally elongated (200×) — 8. *R.* Scalariform perforation. The number of the bars is at least 20, the scales are comparatively broad (250×) — 9. *R.* In the vessels the tiny circular pits are arranged in longitudinal rows. In the perforation the number of the bars is 30 (250×).

Figs of Plate XXIX.

1–9. *Albizzioxylon hungaricum* n. sp. (Szurdokpüspöki, Tortonian).
1. *C.* A diffuse-porous wood. The vessels are for the most part solitary. Annual ring boundary narrow (10×) — 2. *C.* Same magnification from the fossil of *Acacioxylon indicum* Ramanujam. The two pictures are strikingly similar (10×) — 3. *C.* Around the solitary vessels the parenchyma cells are arranged wing- and plate-like (50×) — 4. *C.* The same (100×) — 5. *C.* Around the vessels vasicentric parenchyma. The ground substance is xylem fibre (200×) — 6–8. *C.* The same (200×) — 9. *C.* Detail from *Acacioxylon indicum.* This picture almost completely agrees with Figs 5–8 of our fossil (200×).

Figs of Plate XXX.

10–18. *Albizzioxylon hungaricum* n. sp. (Szurdokpüspöki, Tortonian).
10. *T.* Spindle-shaped homogeneous pith rays with adjacent wood fibres (100×) — 11. Tri- and quadriseriate pith rays with adjacent parenchyma cells. The vessel wall bears minute alveolar pits (100×) — 12. Calcium oxalate crystals in longitudinal parenchyma cells (300× — 13. Quadriseriate pith ray. Minute compressed alveolar pits, with slash-like apertures

(300×) — 14. Parenchyma cells among pith rays (100×) — 15. Quadriseriate homogeneous pith ray, with adjacent parenchyma cells (200×) — 16. *R.* Compressed minute alveolar pits with slash-like apertures in vessel wall (300×) — 17. Parenchyma cells of various shape (100×) — 18. Pith ray structure, with procumbent rectangular ray cells (300×).

Figs of Plate XXXI.

1–9. *Shoreoxylon pénzesi* n. sp. (Budafok, Helvetian).
1. *C.* In the xylem fibre ground tissue solitary and paired pores or multiples of three pores. Around the vessels aliform parenchyma (50×) — 2. *C.* Solitary vessel. Terminal parenchyma (100×) — 3. *C.* In the ground substance two pore pairs (150×)— 4. *T.* Biseriate, spindle-shaped ray (200×) — 5. *T.* In the longitudinal vessel tyloses (200×) — 6. *T.* Solitary vessel, at both ends tapering simple perforation. On the surface of the vessel tiny bordered pits (200×) — 7. *R.* In the wall of the vessels the tiny bordered pits are in alternating position (200×) — 8 and 9. *R.* Heterogeneous ray structure (200×).

Figs of Plate XXXII.

1–9. *Shoreoxylon* sp. (Rudabánya, Pannonian).
1. *C.* Between the solitary and paired vessels 2–3 seriate rays, in the vessels tyloses (50×) — 2. *C.* The same (100×) — 3. *T.* In the vessel tyloses (100×) — 4. *T.* 1–2 seriate rays (100×) — 5. *T.* 2–3 seriate rays (200×) — 6. *T.* The same, the ground substance is xylem fibre (100×) — 7. *T.* Triseriate ray structure (200×) — 8. *R.* Ray structure (200×) — 9. *R.* The same (200×).

Figs of Plate XXXIII.

1–7. *Shoreoxylon* cf. *holdeni* Ramanujam (Tatabánya, Eocene).
1. *C.* The rays are uni- or multiseriate (pseudo ray?), the vessels solitary, aliform terminal parenchyma (150×) — 2. *C.* Annu°l ring boundary blurred, in the vessels tyloses (150×) — 3. Cross slide picture of *Shoreoxylon holdeni* Ramanujam. Not only in the cross section but also in its radial structure conformable to the fossil of Tatabánya (150×) — 4. *R.* Heterogeneous ray structure. In the right side vessel tyloses (200×) — 5. *R.* In the trachea walls the tiny bordered pits are arranged in two rows, parallel with each other (300×) — 6. *R.* On the left side longitudinal parenchyma cells, on the right side in the vessel dark resin content. — 7. *Shoreoxylon holdeni* Ramanujam. Heterogeneous ray structure embracing the pitted rays. The drawings and the structure of the fossil agree with each other.

Figs of Plate XXXIV.

1–6. *Sterculioxylon* sp.? (Dorog, Oligocene).
1. *C.* In the ground tissue paired pores (100×) — 2. *C.* Around a solitary vessel and vasicentric parenchyma (150×) — 3. *R.* On the surface of the vessel dense bordered pitting (200×) — 4. *R.* The same (300×) — 5. *T.* Biseriate rays (100×) — 6. *R.* Ray structure (200×).

Figs of Plate XXXV.

1–4. *Aceroxylon* cf. *palaeosaccharinum* Greguss (Füzérkomlós, Sarmatian).
1. *C.* A diffuse-porous wood, in the ground substance solitary or paired pores or multiples

of three members (50×) — 2. *C.* The same (150×) — 3. *R.* In the cross fields several tiny pits (200×) — 4. *T.* In the walls of the vessels densely arranged alternating bordered pits. Uni- or biseriate rays (200×).

Figs of Plate XXXVI.

1–9. *Ilicoxylon theresiae* n. sp. (Vékény, Helvetian).
1. *C.* Between the broad rays in the ground substance smaller or larger groups of vessels (50×) — 2. *C.* The same (100×) — 3. *C.* The same (150×) — 4. *T.* 4–5 seriate broad rays, in the walls of the tracheae scalariform thickening (150×) — 5. *T.* The same (150×) — 6. *T.* Ray skeleton, 4–5 seriate spindle-shaped rays (150×) — 7. *R.* Scalariform perforation, in the walls of the tracheae only scalariform thickening (200×) — 8. *R.* The same (200×) — 9. *R.* The scalariform perforations are more or less in the same height, in the walls of the vessels only scalariform thickening (200×).

Figs of Plate XXXVII.

1–4. *Ilicoxylon* cf. *aquifolium* Hofmann em. Greguss (Füzérkomlós, Sarmatian).
1. *C.* No conspicuous annual ring boundary, in the ground substance smaller and larger groups of vessels (50×) — 2. *C.* The same (150×) — 3. *R.* In the vessel scalariform perforation, in the cross field several tiny pits (200×) — 4. *T.* 3–4 seriate rays, in the vessels bordered pits arranged in several rows (150×).

Figs of Plate XXXVIII.

1–9. *Vitioxylon megyaszóense* n. sp. (Megyaszó, Lower Pannonian).
1. *C.* The vessels with wide lumina are arranged in the xylem fibre ground substance and between the broad rays (30×) — 2. *C.* Detail of Fig. 1 (50×) — 3. *C.* Beside the vessels with wide lumina the broad rays are running undulately and in the radial direction. The vessels with wide lumina are connected by tracheids with narrow lumina (100×) — 4. *C.* In the vessels with wide lumina tylose primordia and tyloses, paratracheal parenchyma (100×) — 5. *T.* Between the broad rays vessel fields (100×) — 6. *T.* Between the xylem fibres the cross section of a broad ray (300×) — 7. *R.* In the walls of the broad vessels the borders of the bordered pits are elongated and attached to each other (300×) — 8. *R.* In the walls of the vessels the bordered pits are mostly attached opposed to each other (300×) — 9. *R.* The ray cells are horizontally elongated rectangles (300×).

Figs of Plate XXXIX.

1–11. *Citronella* cf. *mucronata* D. Don (Ipolytarnóc, Burdigalian).
1. *C.* Detail of the fossil *Citronella* cf. *mucronata* D. Don (Photo Shilkina). Below, the photo of our fossil, same (50×) magnification. The cross sections of the two fossils perfectly agree. — 1a. *C.* Annual ring boundary hardly noticeable, broad and narrower rays, running at a distance of 4–6 tracheids (50×) — 2. *C.* Detail of Fig. 1 (100×) — 3. *R.* Scalariform perforation, above the perforation an elongated beak, the number of the bars in the perforation is 25 (200×) — 4. *T.* 6–8 cell wide spindle-shaped rays (10×) — 5. *T.* Beside the broad ray fibre tracheids. Ray width = 8 cells (100×) — 6. *R.* In the walls of the vessel the bordered pits are loose, the aperture a vertical slit (600×) — 7. *R.* Homogeneous ray skeleton, in the short ray cells calcium oxalate crystals (100×) — 8. *R.* Scalariform perforation, the bars are comparatively thick, their number is 25 (300×) — 9. *R.* Scalariform perforation, the

bars are thick and thin, at places with transverse walls. *Citronella* character (250×). The photo of Shilkina's fossil is similar (Fig. 10) — 10. *R.* In the wall of the vessel very fine spiral thickening (200×) — 11. Spiral thickenings of the tracheid (600×).

Figs of Plate XL.

1–9. *Icacinoxylon citronelloides* Shilk. (Tokod-Altáró, Oligocene).
1. *C.* No conspicuous annual ring boundary, broad rays — 2. *C.* Detail of Fig. 1 (50×). Below, a detail of Shilkina's fossil — 3. *C.* 7 cell layer wide ray. The cross sections of the vessels are angular. Ground tissue: fibre tracheids (100×) — 4. *T.* The rays are 10–15 cells wide but not too high (5×) — 5. *T.* Detail of a 16 cell wide ray. The marginal cells of the rays are somewhat higher than the interior ones (100×) — 6. *T.* The penetration of tyloses in the interior of the vessel (150×) — 7. *R.* Perforation with 30 scales (200×) — 8. *T.* In the middle scalariform perforation. In the vessels the transverse walls of the tyloses (200×) — 9. *R.* In the left-side vessel spiral thickening. The transverse walls are actually the contacting places of the tyloses (200×).

Figs of Plate XLI.

1–9. *Icacinoxylon* cf. *citronelloides* Shilk. (Ajka, Helvetian).
1. *C.* Annual ring boundary blurred. Broad rays (30×) — 2. *C.* Fibre tracheid ground substance and the vessels (100×) — 3. *T.* Broad ray. On the left side in the vessel scalariform perforation (100×) — 4. *R.* Ray structure. On the right border above the ending of a scalariform perforation (200×) — 5. *R.* Heterogeneous ray structure (200×) — 6. *R.* Two perforations with 30–32 bars. The bars are thin (200×) — 7. *R.* Ray structure (100×) — 8. *R.* The perforation bars (200×) — 9. *R.* Scalariform perforation, the bars are thick (200×).

Figs of Plate XLII.

1–9. *Icacinoxylon* cf. *goderdzicum* Shilk. (Szilvásvárad, Sarmatian).
1. *C.* Hardly noticeable annual ring boundary. Broad rays (30×) — 2. *C.* The same. The cross sections of the vessels are different and of irregular shape (100×) — 3. *C.* Broad ray widening at the annual ring boundary (200×) — 4. *T.* The contact of two broad rays. Short vessel members (100×) — 5. *T.* 15 seriate ray (100×) — 6. *R.* Scalariform perforation. The bars are comparatively broad (300×) — 7. *R.* In the walls of the vessels the bordered pits are alternating (200×) — 8. Heterogeneous ray structure (200×) — 9. *R.* Procumbent ray cells, the vessels end in a long beak. Scalariform perforation. The number of the comparatively broad bars is 25 (200×).

Figs of Plate XLIII.

1–8. *Icacinoxylon hortobágyii* n. sp. (Balaton, Helvetian).
1. *C.* Noticeable annual ring boundary. A diffuse-porous wood (30×) — 2. *C.* Near the annual ring boundary the lumina of the vessels somewhat narrower. In the spring wood the vessels are solitary or paired radially elongated ellipses (100×) — 3. *C.* Broad ray widening at the annual ring boundary; the ground substance is fibre tracheid (300×) — 4. *T.* Broad and comparatively low rays. Between the rays xylem fibres (50×) — 5. *T.* The same (100×) — 6. *T.* Broad ray ending, heterogeneous ray structure. Between the rays xylem fibres (100×) — 7. *R.* Procumbent elongated interior ray cells (200×) — 8. *R.* On the left side (a) and (b) 2 scalariform perforations. The bars are scarce, 4–8 in number. In the walls

of the vessels the bordered pits are arranged in longitudinal and horizontal rows; (c) on the right side in the walls of the vessels (d) the bordered pits are arranged in horizontal and vertical rows, between them spiral thickenings. Scalariform perforation, the bars are broad (300×).

Figs of Plate XLIV.

1–4. *Icacinoxylon laticiphorum* n. sp. (Dorog, Oligocene).
1. *C.* Annual ring boundary blurred, broad rays (50×) — 2. *C.* Solitary vessels in the ground substance (100×) — 3. *T.* In broad rays several milk ducts (left side) (100×) — 4. *C.* Cross section of a longitudinal duct. In its wall epithelial cells (200×).

Figs of Plate XLV.

5–8. *Icacinoxylon laticiphorum* n. sp. (Dorog, Oligocene).
5. *R.* Short vessel members, procumbent ray cells (300×) — 6. *R.* Homogeneous ray strucure (300×) — 7. *R.* Sc alariform perforation (300×) — 8. *R.* Arrangement of bordered pits (300×).

tigs of Plate XLVI.

F–4. *Icacinoxylon crystallophorum* n. sp. (Dorog, Oligocene).
11 *C.* Annual ring boundary blurred, in the ground substance scarce vessels with angular cross section (50×) — 2. *C.* Broad ray and detail of annual ring (100×) — 3. *T.* Broad and high rays (50×) — 4. *T.* Triseriate ray and parenchyma cell including a number of calcium oxalate crystals (100×).

Figs of Plate XLVII.

5–8. *Icacinoxylon crystallophorum* n. sp. (Dorog, Oligocene).
5. *R.* Procumbent ray cells containing calcium oxalate crystals (300×) — 6. *R.* Upright ray cells, in the vessels spiral thickening (in the middle) (200×) — 7. *R.* Scalariform perforation, parenchyma cell containing calcium oxalate (300×) — 8. Perforation with 48 bars (300×).

Figs of Plate XLVIII.

1–9. *Icacinoxylon shilkinae* n. sp. (Pomáz, Helvetian).
1. *C.* A uniform diffuse-porous wood, uni- and multiseriate rays (10×) — 2. *C.* Detail of Fig. 1 (100×) — 3. *C.* Detail of Fig. 2 (100×) — 4. *T.* Uni- and 2–4 seriate rays (10×) — 5. *T.* Aggregate ray (30×) — 6. *T.* Ending of five-seriate ray (100×) — 7. *R.* On the left side in a longitudinal vessel spiral thickening. Heterogeneous ray (200×) — 8. *R.* Scalariform perforation with 35 bars (200×) — 9. *R.* Heterogeneous ray skeleton, on the right side above the bordered pits of the vessels are arranged in oblique rows, at the same place spiral thickening (100×).

Figs of Plate XLIX.

1–9. *Icacinoxylon platanoides* n. sp. (Zirc, Helvetian).
1. *C.* No conspicuous annual ring boundary, wood with diffuse pores, broad rays, in a small amount of ground substance many vessels (10×) — 2. *C.* The broad rays course at

a distance of 10–12 vessels (30×) — 3. *C.* The vessels are solitary or paired (100×) — 4. *T.* The high rays are narrow, spindle-shaped (5×) — 5. *T.* Detail of an 18 cell wide ray (100×) — 6. *T.* Between the rays vessels with short members, in the vessels tyloses. The endings of the rays are uniseriate in a 5–6 cell height. Heterogeneous ray structure (100×) — 7. *R.* In the fibre tracheids the bordered pits are arranged sparsely in longitudinal rows (200×) — 8. *R.* In the left side (a) vessel spiral thickening. On the right side (b) scalariform perforation, before the perforation the bordered pits are arranged beside each other (200×) — 9. *R.* Heterogeneous ray structure, the extreme ray cells are squares or upright oblongs (200×).

Figs of Plate L.

1–9. *Icacinoxylon sylvaticum* (Tuzson) Greguss n. comb. (Ipolytarnóc, Burdigalian).
1. *C.* Broad rays in the ground tissue. Annual ring boundary absent or blurred (30×) — 2. *C.* At the annual ring boundary the broad rays are somewhat widening. No conspicuous annual ring boundary (50×) — 3. *C.* The cross sections of the vessels are polygonal, solitary or paired (100×) — 4. *C.* On the annual ring boundary the broad ray is widening (150×) — 5. The same (150×) — 6. *T.* Beside the broad ray vessels with short members and fibre tracheids (150×) — 7. *T.* Beside the broad ray fibre tracheids (100×) — 8. *T.* Half of a broad ray, in the vessels with short members the pits are arranged beside each other (200×) — 9. *T.* 18 cell wide ray (250×).

Figs of Plate LI.

10–18. *Icacinoxylon sylvaticum* (Tuzson) Greguss n. comb. (Ipolytarnóc, Burdigalian).
10. *R.* In the walls of the vessels the bordered pits thicken spirally (100×) — 11. *R.* Detail of Fig. 10 (200×) — 12. *R.* In the walls of the vessels the bordered pits are arranged beside each other (200×) — 13. *R.* In the walls of the vessels thin spiral thickenings (200×) — 14. *R.* Scalariform perforation, the number of the bars is 40 (200×) — 15. *T.* In the wall of the vessel spiral thickening, the spirals are sometimes branching (200×) — 16. *R.* Scalariform perforation, 28 bars (200×) — 17. *R.* Procumbent ray cells (250×) — 18. *R.* Upright ray cells (250×).

Figs of Plate LII.

1–4. *Icacinoxylon* sp.? (No. 1) seu *Platanoxylon* sp. (Dorog, Oligocene).
1. *C.* The broad rays course at a distance of 4–5 vessels (100×) — 2. *C.* Broad ray and half part of the ground substance (200×) — 3. *T.* Broad rays (10×) — 4. *R.* Heterogeneous ray, in the ray cells calcium oxalate crystals (200×).

Figs of Plate LIII.

1–9. *Icacinoxylon* sp.? (No. 2) seu *Platanoxylon* sp. (Bajna, Oligocene).
1. *C.* No annual ring boundary, broad rays in the ground substance (50×) — 2. *C.* In the ground substance the cross sections of the vessels are angular, of irregular shape (100×) — 3. *T.* The 10–15-seriate rays are long spindle-shaped, between them tracheids and xylem fibres (50×) — 4. *T.* Cross sections of the ray cells in an 18 cell layer wide ray (100×) — 5. *R.* Heterogeneous ray structure, the interior ones are procumbent the marginal ones more upright oblongs or squares. In the ray cells calcium oxalate crystals (200×) — 6. *R.* In the walls of the longitudinal vessels the tiny bordered pits are arranged in longitudinal

rows and opposed (200×) — 7. *R.* In the vessels the number of bars in the scalariform perforation may be even 30 and they are comparatively scarce (300×) — 8. *R.* In the walls of the longitudinal broad vessels dense spiral thickenings, between them the tiny bordered pits are arranged in longitudinal rows (300×) — 9. *R.* In the longitudinal vessels dense spiral thickenings (300×).

Figs of Plate LIV.

1–9. *Icacinoxylon* sp.? (No. 3) seu *Platanoxylon* sp. (Cserháthaláp, Helvetian).
1. *C.* No annual rings, between the broad rays narrower ones are running, the ground tissue is xylem fibre (30×) — 2. *C.* Broad ray and detail of the ground substance (100×) — 3. *C.* In the ground substance the cross sections of the solitary or paired vessels are angular or rounded off, the ground substance is xylem fibre (100×) — 4. *T.* Beside the 10–15 seriate rays 4–5 seriate ones are running, in the rays horizontal ducts (50×) — 5. *T.* In the wide ray transverse duct (100×) — 6. *R.* Ray structure; in the ray cells calcium oxalate crystals (200×) — 7. *R.* In the scalariform perforation of the longitudinal vessels the number of bars may amount to 30 (300×) — 8. *R.* In the scalariform perforation 30 bars (300×) — 9. *R.* Detail of a scalariform perforation (300×).

Figs of Plate LV.

1–9. *Icacinoxylon* sp.? (No. 4) seu *Platanoxylon* sp. (Várpalota, Lower Helvetian).
1. *C.* The very broad rays course at a distance of 3–5 vessels (50×) — 2. *C.* No annual ring boundary, the vessels are generally solitary, around them the fibre tracheid ground substance is dominant (100×) — 3. *C.* Structure of the ground substance and of the cross section of the vessels (200×) — 4. *T.* The cross sections of the 10–15 cell wide rays are elongated spindle-shaped, in the rays horizontal ducts are running (30×) — 5. *T.* 10–12 seriate rays, in the right side one 2 horizontal ducts (100×) — 6. *T.* In a broad ray the cross sections of the cells are generally rounded off (200×) — 7. *R.* In the perforations of the longitudinal vessel the number of bars may amount to 30 (300×) — 8. *R.* Heterogeneous ray structure; in some ray cells Ca-oxalate crystals (200×) — 9. *R.* In the longitudinal tracheid walls thin spiral thickenings (300×).

Figs of Plate LVI.

1–6. *Icacinoxylon* sp.? (No. 5) seu *Platanoxylon* sp. (Cinkota, Helvetian).
7–9. *Icacinoxylon* sp.? (No. 17) seu *Platanoxylon* sp. (Nagybátony, Burdigalian).
1. *C.* No annual rings, between two broader rays 2–3 narrower rays are running; ground substance entirely compressed (30×) — 2. *C.* Detail of Fig. 1 (50×), in the ground substance at places cross sections of compressed vessels are seen — 3. *R.* Beside the longitudinal vessels cell with Ca-oxalate crystal row (200×) — 4. *T.* The broad rays are elongated spindle-shaped (30×) — 5. *T.* Detail of 8–10 seriate ray (100×) — 6. *R.* In the longitudinal tracheid walls scalariform perforations (300×) — 7. *C.* No annual ring, 10–15 cell wide rays (50×) — 8. *T.* Perforation of a vessel (200×) — 9. *R.* Spiral thickening in the vessel (200×).

Figs of Plate LVII.

1–9. *Icacinoxylon* sp.? (No. 6) seu *Platanoxylon* sp. (Pécsszabolcs, Helvetian).
1. *C.* In the compressed ground substance narrow and broader rays are running (30×) — 2. *C.* The ground substance is scanty as compared to the vessels which are almost contacting

each other (100×) — 3. *C.* Among the vessels there is scarcely any fibre tracheid ground substance (200×) — 4. *T.* In the broad ray horizontal duct. The cross sections of the ray cells are rounded off or polygonal (100×) — 5. *T.* Detail of a 20 cell wide ray (50×) — 6. *T.* Cross-section structure of a broad ray; on the right side horizontal duct (100×) — 7. *R.* Ray structure; the interior ones are procumbent rectangles, the marginal ones more upright oblongs or squares, in some of them calcium-oxalate crystals (200×) — 8. *R.* The same as in 7 (200×) — 9. *R.* In the longitudinal tracheids tyloses. In the vessels the white circles are not bordered pits. See also Figs 7 and 8.

Figs of Plate LVIII.

1–7. *Icacinoxylon* sp.? (No. 7) seu *Platanoxylon* sp. (Mór, Helvetian).
8 and 9. *Icacinoxylon* sp.? (No. 8) seu *Platanoxylon* sp. (Megyaszó, Sarmatian).
1. *C.* Hardly noticeable annual ring boundaries, broad rays (6×) — 2. C. The broad rays course at a distance of 4–6 tracheae. The cross sections of the vessels are radially somewhat elongated polygons (30×) — 3. *C.* Between two broad rays in the ground substance generally solitary vessels (50×) — 4. *T.* 8–10 cell wide and very high rays (10×) — 5. *T.* The broad rays at their ends continue over a rather large sector in one layer. Heterogeneous ray structure (50×) — 6. *T.* 15 cell layer wide ray (100×) — 7. *R.* Detail of scalariform perforation (300×) — 8. *C.* Between the solitary vessels the ground substance consists of fibre tracheids (200×) — 9. *R.* Ray structure and the ending of a scalariform perforation; the bars are thin (300×).

Figs of Plate LIX.

Icacinoxylon sp.? seu *Platanoxylon* sp.
1–3 (No. 15) (Pénzeskút, Helvetian); 4 and 5 (No. 9) (Budapest, Helvetian); 6 (No. 10) (Hárságy, Helvetian); 7 and 8 (No. 14) (Solymár, Oligocene); 9 (No. 16) (Rátka, Sarmatian).
1. *C.* Between the broad rays wide tracheal fields. — 2. *T.* Between the broad rays fibre tracheids. — 3. *R.* At the ends of the vessels scalariform perforation, in the wall of the vessels spiral thickening. — 4. *C.* Between the broad rays vessels with wide lumina (50×) — 5. *T.* Between the xylem fibres broad rays (100×) — 6. *T.* Between the fibre tracheids very wide ray (50×) — 7. *C.* Between the broad rays the vessels with wide lumina are uniformly distributed (50×) — 8. *T.* Between the fibre tracheids and vessels broad rays (50×) — 9. *C.* Between the broad rays wide field of vessels. Between the fibre tracheids vessels with wide lumina (50×). Cf. Figs 1–4 and 7.

Figs of Plate LX.

1 and 2. *Icacinoxylon* sp.? (No. 11) seu *Platanoxylon* sp. (Bodajk, Lower Helvetian).
3–6. *Icacinoxylon* sp.? (No. 12) seu *Platanoxylon* sp. (Iszkaszentgyörgy, Helvetian).
7–9. *Icacinoxylon* sp.? (No. 13) seu *Platanoxylon* sp. (Homokbödöge, Helvetian).
1. *C.* Besides the broad ray the solitary vessels are arranged dispersedly in broad fields (50×) — 2. *T.* The rays are 1–12 cells wide, 60–120 cells high (7×) — 3. *T.* The rays are 1–12 cells wide, 60–80 cells high (7×) — 4. *C.* Between the broad rays and the xylem fibre generally single vessels (50×) — 5. *R.* In the walls of the vessels spiral thickening (300×) — 6. *R.* In the narrower vessel tyloses, in the broader vessel 30 scales in the scalariform perforation (300×) — 7. *C.* Between the broad rays in the fibre ground substance solitary vessel (30×) — 8. *T.* The rays are 1–12 cells wide, 70–80 cells high (7×) — 9. *R.* In the ray cell calcium oxalate crystals (300×).

Figs of Plate LXI.

1–9. *Icacinoxylon* sp.? (No. 17) seu *Platanoxylon* sp. (Nagybátony, Burdigalian).
1. *C.* A diffuse-porous wood with broad rays. Annual ring boundary noticeable (10×) — 2. *C.* An annual ring, in the middle double ring limits (100×) — 3. *C.* Vessels angular or rounded off, broad ray widening at the annual ring boundary. Ground substance fibre tracheids (150×) — 4. *T.* The spindle-shaped rays are wide. Ground substance fibre tracheids (10×) — 5. *T.* 12 cell wide rays (25×) — 6. *R.* In the vessel scalariform perforation, in its wall the bordered pits are dispersed. In the left side vessel spiral thickening (200×) — 7. *R.* In the tracheid walls scalariform perforation. On the right side tapering vessel ending with scalariform perforation (200×) — 8. *R.* In the wall of the vessel members spiral thickening, in the walls of the fibre tracheids pits arranged in 1 or 2 rows (200×) — 9. *R.* Detail of the heterogeneous ray, square peripheral cells (200×).

Figs of Plate LXII.

1–8. *Icacinoxylon* sp.? (No. 18) seu *Platanoxylon* sp. (Nógrád, Helvetian).
1. *C.* Between broad rays vessels with diffuse pores, annual ring boundary blurred (10×) — 2. The same (50×) — 3. *C.* Broad ray at the annual ring boundary somewhat widening (100×) — 4. *T.* 8–15-seriate rays with horizontal ducts (10×) — 5. *T.* Interior structure of a broad ray (100×) — 6. *T.* Vessels with short members beside the rays (200×) — 7. *R.* Beside the scalariform perforation spiral thickening (200×) — 8. *R.* Left side (a): scalariform perforation with 30 bars, low vessel members; middle (b, c): vessel with spiral thickening; right side: procumbent ray cells, in the vessel spiral thickening (d) (200×).

Figs of Plate LXIII.

1–7. *Alnus* sp. (Emőd, Pleistocene).
1. *R.* Scalariform perforation of the vessel, the number of bars is 25 (600×) — 2. *R.* The same (600×) — 3. *R.* In the tracheid walls the tiny bordered pits are attached closely to each other, their aperture is a horizontal slit (600×) — 4. *R.* Characteristic Alnus-like scalariform perforation (300×) — 5. *R.* The same. Gradual transition in the scalariform perforation (200×) — 6. *R.* Scalariform perforation, some scales are branching (200×) — 7. *R.* The same (200×).

Figs of Plate LXIV.

1–4. *Carpinoxylon hungaricum* Greguss (Füzérkomlós, Sarmatian).
1. *C.* The aggregate rays course at a distance of 4–6 vessels. No conspicuous annual ring boundary (50×) — 2. *C.* The same. In the ground substance solitary vessels and two multiples of five members, radially arranged also pore groups (150×) — 3. *R.* Heterogeneous ray structure (200×) — 4. *T.* In the walls of the vessels dense bordered pits (150×).

Figs of Plate LXV.

1–6. *Carpinoxylon* sp. (Ipolytarnóc, Burdigalian).
7 and 8. *Ulmus* sp. (Újfalu, Pleistocene).
1. *C.* Compact ground substance, solitary and paired pores, 1–2 seriate rays (30×) — 2. *C.* Detail of Fig. 1, paired pores (100×) — 3. *T.* 1–2 seriate rays at places aligned more densely (100×) — 4. *R.* In the rays rectangle and square shaped pith ray cells (100×) — 5. *R.* In the

broader vessels spiral thickenings and bordered pits; simple perforation (300×) — 6. *R* In the vessels bordered pits and spiral cell wall thickening. The aperture of the bordered pits is circular (300×) — 7. *C.* (100×) — 8. *T.* (100×).

Figs of Plate LXVI.

1–3, 6, 6a and 9. *Quercoxylon suberoides* n. sp. (Sály, Sarmatian).
4, 5, 7 and 8. *Quercoxylon* sp. (No. 3) (Pestszentlőrinc, Pannonian).
1. *C.* On the annual ring boundary in the spring wood the vessels with wide lumina are arranged generally in one row (30×) — 2. *C.* The same (50×) — 3. *C.* In the annual ring among xylem fibres dispersed parenchyma cells (150×) — 4. *C.* In the spring wood few vessels with wide lumina. In the middle of the picture 2 broad rays (30×) — 5. *C.* Detail of Fig. 4 (100×) — 6. *R.* Pitting of the wide trachea at the contact of the ray cells (300×) — 6a. *R.* Pitting of a ray of *Quercus suber* (recent) (300×) — 7. *T.* Beside the broad ray uniseriate rays (100×) — 8. *R.* Detail of ray (200×) — 9. *T.* Beside the broad ray in the uniseriate rays calcium oxalate crystals (200×).

Figs of Plate LXVII.

1–3. *Quercoxylon* sp. (No. 1) (Monosbél, Helvetian).
4–6. *Quercus* sp. (No. 2) (Cegléd, Pleistocene).
7–9. *Liquidambaroxylon* cf. *styraciflua* (Sámsonháza, Helvetian).
1. *C.* A ring-porous wood. The vessels with narrow lumina and the tracheids are grouped in the annual ring in narrower or broader fields (7×) — 2. *C.* The same (30×) — 3. *T.* Beside the broad ray uniseriate rays (50×) — 4. *C.* A ring-porous wood. In the spring wood the vessels with large lumina are loosely attached to each other and gradually narrowing towards the annual ring boundary (7×) — 5. *C.* The same (30×) — 6. *T.* Beside the broad ray uniseriate rays (100×) — 7. *C.* Lone vessels with scattered pores (100×) — 8. Scalariform perforation in vessels. Radial polished section (300×) — 9. Bi- to quadriseriate tall pith rays (100×).

Figs of Plate LXVIII.

1–4. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 1) (Kemenesmagasi, Pannonian).
5–7. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 2) (Tata, Oligocene).
8. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 3) (Dorog, Oligocene).
1. *C.* A wood with annular pores (7×) — 2. *C.* Detail of Fig. 1 (30×) — 3. *T.* Uni- and multiseriate ray (100×) — 4. *R.* Ray structure (200×) — 5–7. *C.* *Quercoxylon böckhianum* (Photo Rákosi) (100×) — 8. The same. Annual ring structure.

Figs of Plate LXIX.

1–9. *Pterocaryoxylon pannonicum* Müller-Stoll and Mädel (Parádfürdő, Lower Helvetian).
1. *C.* A diffuse-porous wood, the vessels are paired (7×) — 2. *C.* The same (30×) — 3. *C.* Paratracheal parenchyma (100×) — 4. *T.* 1–2 seriate rays (100×) — 5. *T.* In the uniseriate rays a number of oxalate crystals (100×) — 6. The same (200×) — 7. *T.* In the walls of the vessels the bordered pits are alternating (300×) — 8. *T.* The end of the vessel is narrowing, simple perforation. The wall of the vessel is thick (300×) — 9. *T.* Pitting of the ray parenchyma (300×).

Figs of Plate LXX.

1–4. *Pterocaryoxylon* cf. *pannonicum* Müller-Stoll and Mädel (Nemti, Lower Helvetian).
1. *C.* In the ground substance the vessels are solitary or paired. Apotracheal parenchyma (70×) — 2. *C.* The same (150×) — 3. *R.* Heterogeneous ray. In the longitudinal parenchyma cells calcium oxalate crystals (20×) — 4. *T.* In the longitudinal parenchyma cells calcium oxalate crystal (250×).

Figs of Plate LXXI.

1–9. *Pterocaryoxylon pilinyense* n. sp. (Piliny, Helvetian).
1. *C.* In the xylem fibre ground tissue solitary and paired vessels, apotracheal and vasicentric parenchyma (100×) — 2. *C.* Detail of Fig. 1. Two-membered short pore multiple (100×) — 3. *C.* Around the vessel parenchyma (100×) — 4. *R.* In the walls of the vessels the bordered pits are attached closely to each other (300×) — 5. *T.* 1–3 seriate rays, the broader vessel tyloses (100×) — 6. *T.* 1–3 seriate heterogeneous ray skeletons (200×) — 7. *T.* Calcium oxalate crystals in the ray cells (300×) — 8. *T.* Beside the heterogeneous rays longitudinal parenchyma cells (200×) — 9. *R.* Upright and procumbent ray cells (300×).

Figs of Plate LXXII.

1–9. *Eucaryoxylon budense* n. sp. (Budapest, Lower Helvetian).
1. *C.* The vessels with wide lumina are localized more on the annual ring boundary. Apotracheal parenchyma, 1–2 seriate rays (50×) — 2. *C.* From *Carya alba* (recent). The vessels on the annual ring boundary, 1–2 seriate rays. Apotracheal parenchyma. High degree of similarity to Fig. 1 (50×) — 3. *C.* Apotracheal parenchyma plates, solitary and paired vessels (100×) — 4. *C.* 1–2 seriate rays. In the solitary idioblast calcium oxalate crystal (200×) — 5. *T.* Biseriate ray continues as uniseriate over a long sector (200×) — 6. *T.* Biseriate ray (200×) — 7. *C.* Double vessel, in the upper right corner solitary idioblast, containing solitary calcium oxalate crystal (200×) — 8. *C.* Solitary vessel, apotracheal parenchyma, above in the middle solitary idioblast. Solitary calcium oxalate crystal (200×) — 9. *R.* Heterogeneous ray structure (300×).

Figs of Plate LXXIII.

1–4. *Eucaryoxylon crystallophorum* Müller-Stoll and Mädel (Füzérkomlós, Sarmatian). (*Pterocarya* cf. *massalongi* Greguss).
1. *C.* *Pterocarya stenoptera*, recent. A wood with dispersed pores, solitary vessels, paired pores or short pore rays, terminal parenchyma (50×) — 2. *C.* Terminal parenchyma (100×) — 3. *R.* Procumbent ray cells (200×) — 4. *T.* 1–4 seriate rays (150×).

Figs of Plate LXXIV.

1.–9. *Populoxylon* sp. (cf. *Populus alba*) (Mikófalva, Sarmatian).
1. *C.* A diffuse-porous wood. In the ground substance solitary vessels, paired pores and multiples arranged in a radial direction (30×) — 2. *C.* The same (100×) — 3. *R.* The same (100×) — 4. *T.* Uniseriate, 10–12 cell high rays (100×) — 5. *T.* The same — 6. *R.* Heterogeneous ray structure. In the lower three cross fields simple pits in two rows (300×) — 7. *R.* In the walls of the vessels the bordered pits are alternating. Their aperture is oblique (300×) — 8. *R.* In the terminal cells of the rays in the cross fields 2–3 seriate simple pits (300×) — 9. *R.* The same. In the walls of the vessels the borders of the bordered pits are in contact (300×).

Figs of Plate LXXV.

1–5. *Populoxylon* sp. (cf. *Populus tremula* L.) (Mikófalva, Sarmatian).
6–10. *Ulmoxylon* sp. (cf. *Ulmus scabra* Mill.) (Szigliget, Helvetian).
1. *C.* A diffuse-porous wood, at the beginning of the early wood the vessels are arranged denser and they are also somewhat larger than in the late wood (300×) — 2. *C.* The same (100×) — 3. *T.* The uniseriate rays are 1–20 cells high (100×) — 4. *R.* In the walls of the vessel the bordered pits are attached to each other in oblique rows and densely compressed (300×) — 5. *R.* In the ray cells the large simple pits are arranged in two rows (200×) — 6. *C.* On the annual ring boundary groups of wide vessels, in the annual rings smaller or larger groups (30×) — 7. *C.* The same (10×) — 8. *T.* Homogeneous wide and high rays (100×) — 9. *R.* In the narrow tracheae spiral thickening (300×) — 10. *R.* In the wall of the broad vessel the borders of the tiny bordered pits are rounded off (300×).

Figs of Plate LXXVI.

1–9. *Zelkovoxylon yatsenko-khmelevskyi* n. sp. (Nógrádszakál, Lower Sarmatian).
1. *C.* A ring-porous wood on the annual ring boundary solitary, paired vessels or multiples of three members. Diameter of vessels 350–400 μ (30×) — 2. *C.* Detail of Fig. 1 (100×) — 3. *C.* Vessels, tracheids and xylem fibre. In the vessels tyloses (200×) — 4. *T.* Ray skeleton. Homogeneous ray structure, 40 cell high and 4 cell wide rays. In the parenchyma cells solitary calcium oxalate crystals (50×) — 5 and 6. The same (100×) — 7. *R.* Homogeneous ray structure (100×) — 8. *R.* The same. In the longitudinal parenchyma cells calcium oxalate crystals (200×) — 9. *R.* In the tracheal wall tiny bordered pits, their apertures slit-like (300×).

Figs of Plate LXXVII.

1–9. *Ulmoxylon scabroides* n. sp. (Sámsonháza, Helvetian).
1. *C.* A ring-porous wood, the ground substance of the annual ring is xylem fibre (30×) — 2. *C.* The structure of an annual ring, after the zone of the spring vessel with wide lumina in the ground substance trachea groups with narrow lumina (100×) — 3. *C.* In the ground substance of fibre tracheids with narrow lumina smaller or greater groups of vessels (200×) — 4. *T.* The arrangement of the rays on the tangential side; on the left side the vessel members are arranged in storeys (30×) — 5. *T.* 20 cell high and 5 cell wide rays, beside them xylem fibres and wood parenchyma (100×). Homogeneous ray skeleton — 6. *T.* Detail of Fig. 5 (200×) — 7. *R.* Ray structure, in the middle a vessel with simple perforation (200×) — 8. *R.* Homogeneous ray structure, the wall of the longitudinal vessel is covered with dense and tiny bordered pits (200×) — 9. *R.* Ray structure, among the xylem fibres calcium oxalate crystal rows (300×).

Figs of Plate LXXVIII.

1–4. *Ulmoxylon* cf. *carpinifolia* Gled. (Pásztó, Sarmatian–Pannonian).
1. *C.* A ring-porous wood, the spring tracheids are arranged in 2–3 rows. In the late wood groups of vessels with narrow lumina (50×) — 2. *C.* In the autumn wood larger or smaller groups of vessels, on the annual ring boundary vessels with wide lumina (150×) — 3. *T.* The rays are 6–7 cells wide, homogeneous ray structure (300×) — 4. *R.* The equally high ray cells are elongated (350×).

Figs of Plate LXXIX.

1–4. *Celtixylon campestre* (Hofmann) n. comb. (Füzérkomlós, Sarmatian).
1. *C*. In the annual ring field larger or smaller groups of vessels. A ring-porous wood (50×) — 2. *C*. Groups of vessels and parenchyma groups (150×) — 3. *R*. Heterogeneous ray structure (200×) — 4. *T*. The peripheral cells of the rays are much larger than the interior ones (Scheidenzellen) (150×).

Figs of Plate LXXX.

1–9. *Meliaceoxylon matrense* n. sp. (Mátranovák, Lower Helvetian).
1. *C*. A diffuse-porous wood, the vessels are paired or grouped radially in short multiples of 3 to 6 members (15×) — 2. *C*. The same (50×) — 3. *C*. Solitary vessel, in the resin duct dark resin content (100×) — 4. *T*. 2–3 seriate broad heterogeneous rays. Near the rays parenchyma cells (100×) — 5. *T*. Heterogeneous pith rays between the xylem fibres (100×) — 6. *T*. Heterogeneous ray skeleton (200×) — 7. *T*. 2–3 seriate rays. Short paratracheal parenchyma cells (200×) — 8. *R*. Ray structure (300×) — 9. *R*. Heterogeneous ray structure (300×).

Figs of Plate LXXXI.

1–9. *Euphorbioxylon secretiphorum* n. sp. (Szarvaskő, Helvetian).
1. *C*. In the compressed wood the contours of the broad rays appear (30×) — 2. *C*. In the ground tissue longitudinal ducts with wide lumina are filled in most cases with a white granular substance (100×) — 3. *C*. In the ducts with wide lumina the white granular substance is distinctly seen (at No. 3) (150×) — 4. *R*. In broad rays the interior ray cells appear as elongated, procumbent rectangles (200×) — 5. *R*. Heterogeneous ray structure, beside the horizontally elongated ray cells upright oblong-shaped ray cells are situated (200×) — 6. *C*. In the interior of remarkably spacious duct white granular content (200×) — 7. *R*. In the walls of the longitudinal tracheids the bordered pits lie oblong-like compressed (300×) — 8. *R*. The longitudinal tracheae communicate with each other through a scalariform perforation with 30–35 bars (200×) — 9. *R*. Detail of a scalariform perforation (300×).

Figs of Plate LXXXII.

1–9. *Euphorbioxylon secretiphorum* n. sp. (Szarvaskő, Helvetian).
1. *T*. Broad ray continues at a height of 6–8 cells uniseriately (100×) — 2. *T*. 8–10 seriate rays (50×) — 3. *T*. The same (100×) — 4. *T*. Ending of broad ray, continuation Fig. 1 (100×) — 5. *T*. 5-seriate ray, beside xylem fibres (100×) – 6. *T*. In an 8 seriate ray horizontal duct (100×) — 7. *R*. Scalariform perforations, above upright ray cell, beside procumbent short ray cell, so the ray is heterogeneous (200×) — 8. *R*. Detail of scalariform perforation (200×) — 9. *R*. Scalariform perforations among the compressed ground substance (200×).

Figs of Plate LXXXIII.

1–4. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene).
1. *C*. No annual ring boundary, short pore multiples, at the right and left border a longitudinal duct each with white content (50×) — 2. *C*. Between two rays milk cells. Compare Photo 3 (300×) — 3. *C*. Ground substance xylem fibre, in the milk ducts granular content (at the arrow) (300×) — 4. *C*. The same (600×).

Figs of Plate LXXXIV.

5–8. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene).
5. *T.* 2–3 seriate rays, in the vessels tyloses (100×) — 6. *T.* 2–3 seriate rays, containing milk cells (200×) — 7. The same. On the right side beside the ray thin-walled parenchyma cell, in the ray thin-walled milk cell (300×) — 8. *T.* On the surface of the vessel opposed circular bordered pits, the aperture is a horizontal slit or a circle (600×).

Figs of Plate LXXXV.

9–12. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene).
9. *T.* In the biseriate rays at some places thin-walled milk cells (at the arrow) (600×) — 10. *T.* The ending of two vessels, cross section of probable scalariform perforation (600×) — 11. *T.* The ending of two vessels. Probable scalariform perforation (600×) — 12. *T.* In the vessel tyloses, on the surface alternating bordered pits, in the ray thin-walled milk cell (300×).

Figs of Plate LXXXVI.

13–16. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene).
13. *R.* Heterogeneous ray, three longitudinal parenchyma cells, the horizontal walls of which are thin (300×) — 14. *R.* Heterogeneous ray structure, the horizontal walls of the longitudinal parenchyma cells are thin and apparently smooth — 15. *C.* The structure of a milk cell (600×) — 16. *R.* Heterogeneous ray structure (300×).

Figs of Plate LXXXVII.

1–9. *Euphorbioxylon remyi* n. sp. (Nógrádszakál, Sarmatian).
1. *C.* Uniform annual ring field, no annual ring border, among the vessels much larger milk cells are dispersed (50×) — 2. *C.* Detail of Fig. 1, below solitary milk cell (100×) — 3. *C.* The same (150×) — 4. *C.* Triseriate thin-walled ray (100×) — 5. *C.* 4-seriate broad thin-walled ray, between the vessels thin-walled parenchyma cells (100×) — 6. *C.* Three-membered milk cell (100×) — 7. *T.* 1–2 seriate and 1–15 cell high rays, in some ray cells dark content (50×) — 8. *T.* 1–2 seriate rays (100×) — 9. *T.* Biseriate heterogeneous rays, the ray cells are of different size (100×).

Figs of Plate LXXXVIII.

10–18. *Euphorbioxylon remyi* n. sp. (Nógrádszakál, Sarmatian).
10. *R.* Heterogeneous ray structure. The median ray cells are procumbent, the marginal ones upright oblongs. In some cells a dark content (200×) — 11. *R.* The same (300×) — 12. *C.* Solitary milk cell, in the upper part a horseshoe-shaped characteristic cell (150×) — 13. *R.* Scalariform perforation or in the wall of the vessel scalariform thickening (300×) — 14. *R.* The same, in the wall of the vessel horizontally elongated pits (300×) — 15. *R.* The inner content of a longitudinal milk cell. Compare shape and width of the milk cell in Fig. 12 (300×) — 16. *R.* A longitudinal milk cell with white content (300×) — 17. *R.* The same, the content of the milk cell at places interrupted (300×) — 18. *R.* White content of longitudinal milk cell, in the middle transverse wall (300×).

Figs of Plate LXXXIX.

1, 4, 6 and 7. *Ebenoxylon knollii* Hofmann (Sirok, Oligocene).
3, 5, 8 and 9. *Ebenoxylon hofmannae* Greguss (Sirok, Oligocene).

2. *Diospyros lotus* L. (recent).

1. *C. Ebenoxylon knollii.* At 8–10 vessel distances metatracheal parenchyma plates (100×) — 2. *C. T. Diospyros lotus*, recent (photo by Müller-Stoll). Loose, terminal parenchyma (100×) — 3. *C. Ebenoxylon hofmannae.* Dense terminal parenchyma (100×) — 4. *T. Ebenoxylon knollii.* Biseriate high rays, crystal-holding parenchyma (100×) — 5. *T. Ebenoxylon hofmannae.* Low, bi- and triseriate rays (100×) — 6. *R. Ebenoxylon knollii.* On the right side crystal-holding parenchyma (300×) — 7. *R. Ebenoxylon knollii.* Crystal-holding parenchyma (100×) — 8. *R. Ebenoxylon hofmannae.* Heterogeneous ray calcium oxalate crystals (300×) — 9. *C.* Vessels and terminal parenchyma (100×).

Figs of Plate XC.

1. *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian).
5. *Diospyros ebenaster* Retz (recent).
2, 3, 6, 7, 9–11. *Diospyroxylon* cf. *ebenaster* Retz (Ipolytarnóc, Burdigalian).
4, 8, 8a. *Diospyroxylon* sp. (Érd–Törökbálint, Helvetian).
12. *Ulmoxylon* sp. Greguss (Mátraverebély, Helvetian).

1. *C.* (50×) — 2. *C.* Terminal rows of parenchyma and lone or twin pores (100×) — 3. *C.* The same fossil (150×) — 4. *C.* Terminal rows of parenchyma (150×) — 5. *T.* Uniseriate pith rays with close-spaced bordered pits in the vessel wall (150×) — 6. Uniseriate, tall pith rays (150×) — 7. The same, with calcium oxalate crystals in the pith rays (150×) — 8, 8a. Bi- and quadriseriate pith rays (250×) — 9. Minute bordered pits in the vessel wall, recalling living *Diospyros ebenaster* (150×) — 10. The same (300×) — 11. Heterogeneous pith ray structure (300×) — 12. Pith ray structure (250×).

Figs of Plate XCI.

1–3. *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian).
4. *Fraxinoxylon* cf. *Fraxinus excelsior* L. (Pestszentlőrinc, Pleistocene).

1. *C.* Solitary pore pairs or short multiples. Terminal parenchyma (150×) — 2. *T.* 3–4 seriate heterogeneous ray structure, on the trachea walls dense bordered pits. Paratracheal parenchyma (150×) — 3. *R.* About the vessels paratracheal parenchyma. Longitudinal parenchyma cells (150×) — 4. *T. Fraxinoxylon* cf. *Fraxinus excelsior* (Pestszentlőrinc, Pleistocene). Among the 1–2 seriate rays short parenchyma rows (150×).

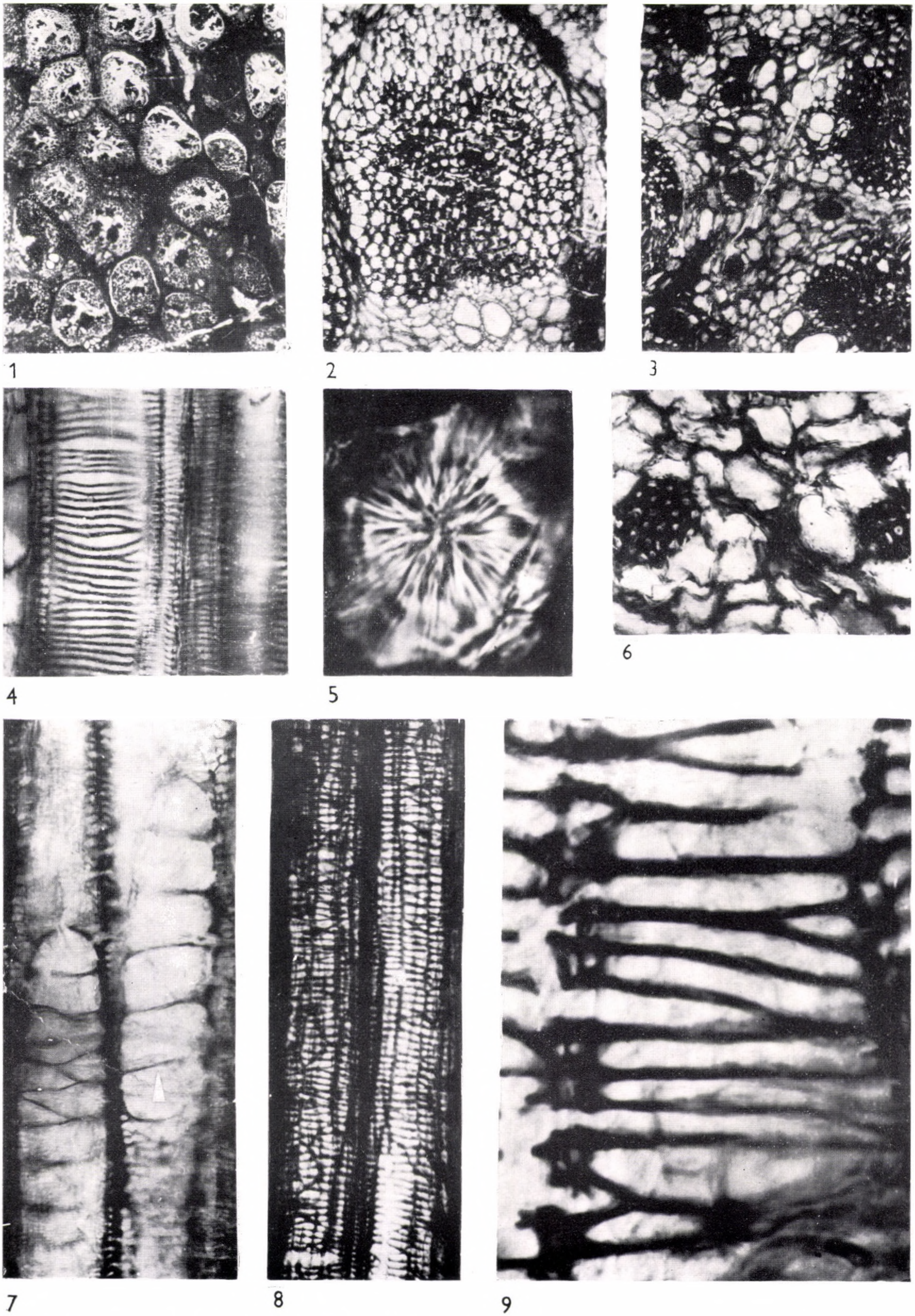
Figs of Plate XCII.

1. *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian). *C.* Paired pores (100×) — 2. *Erica arborea* L. (recent); *C.* Paired pores (100×) — 3a. *T.* Ray skeletons: *Ulmus campestris* (recent) (200×) — 3b. *Celtioxylon palaeohungaricum* — 3c. *R. Celtis australis* (recent) — 3d. *R. Zelkova keaki* (recent).

Figs of Plate XCIII.

1–4. *Fraxinioxylon* cf. *Fraxinus excelsior* L. (Pestszentlőrinc, Pleistocene).

1. *C.* Ring-porous wood, on the annual ring boundaries the vessels are generally arranged in one row (15×) — 2. *C.* The solitary or paired vessels are situated on the annual ring boundary in one row. In the annual ring the vessels are surrounded by paratracheal parenchyma (100×) — 3. *T.* Short parenchyma cells adhere closely to the uni- and biseriate rays (300×) — 4. *R.* 12 cell high heterogeneous ray (300×).



I. 1–9. *Palmoxylon dorogense* n. sp. (Dorog, Oligocene)

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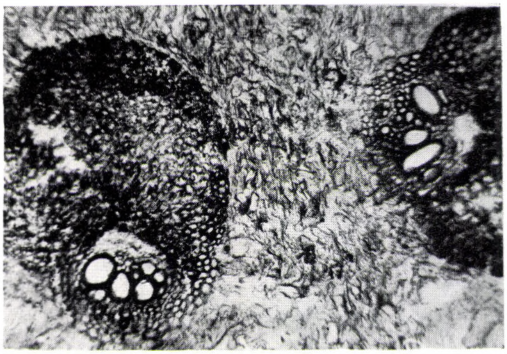

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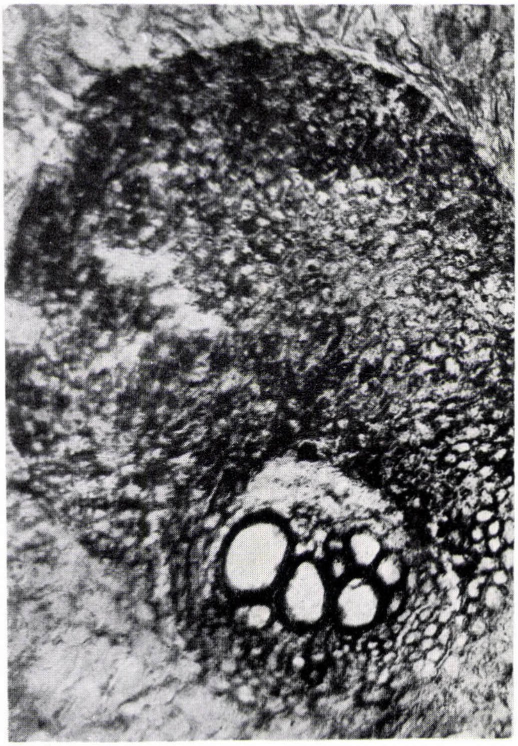

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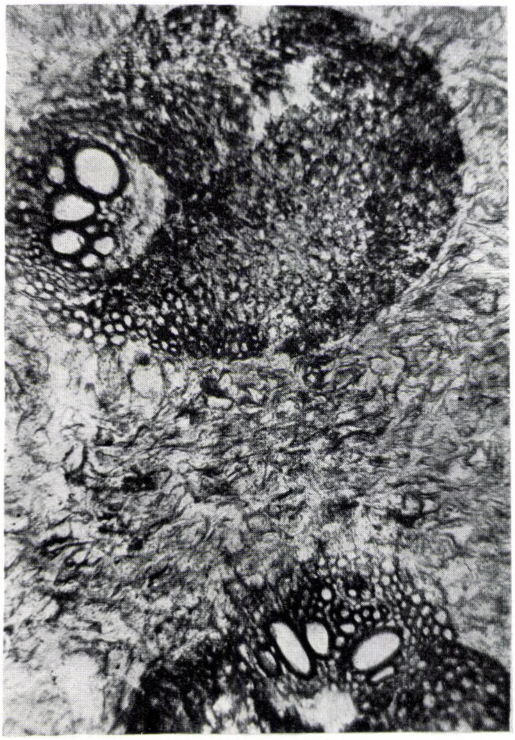

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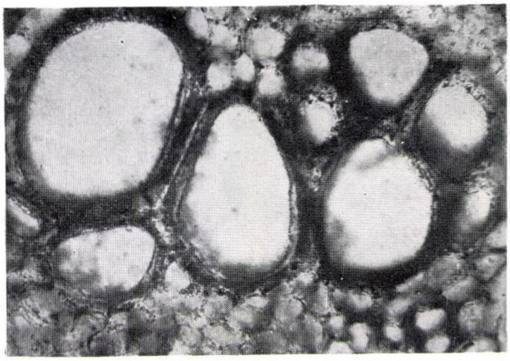

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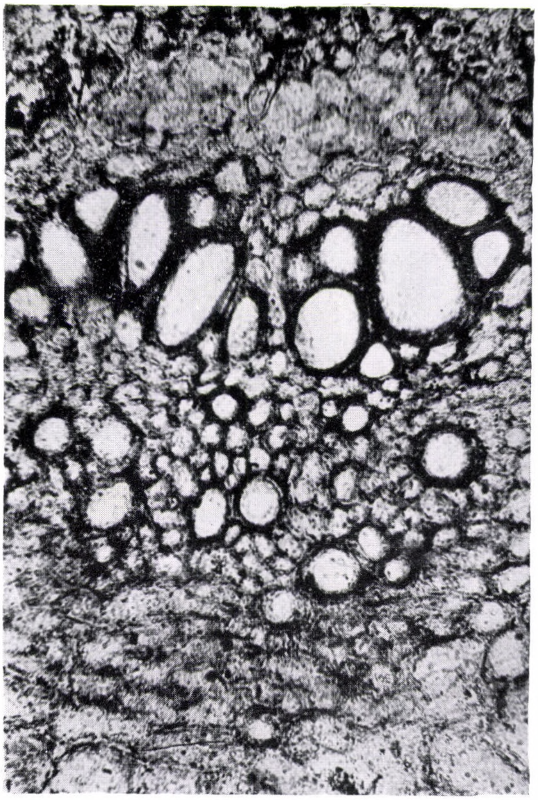
II. 1–6. *Palmoxylon sabaloides* Greguss (Ipolytarnóc, Burdigalian)



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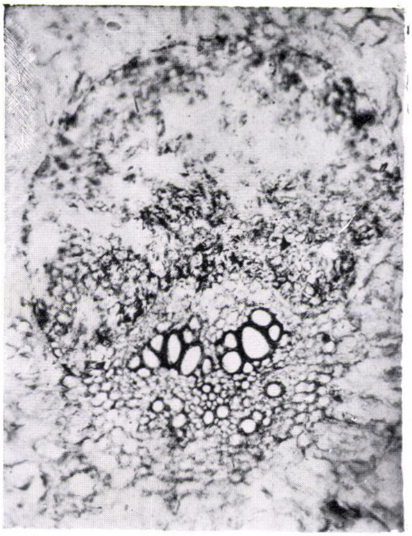

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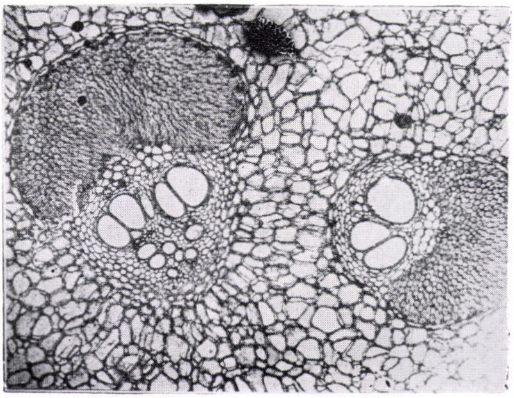

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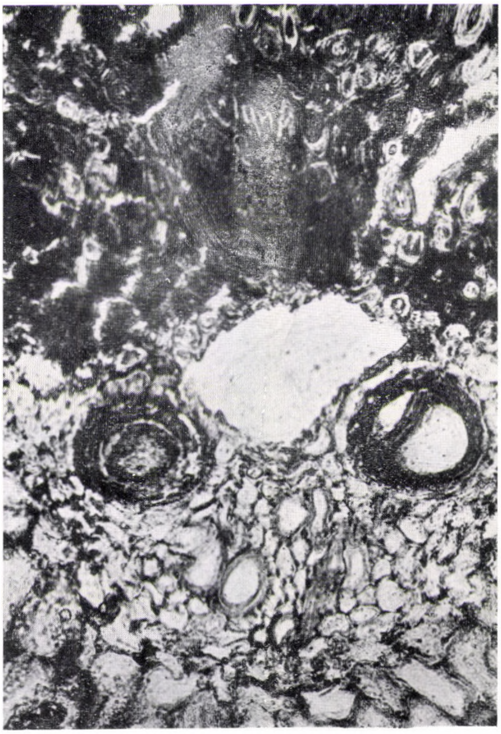
III. 7–11. *Palmoxylon sabaloides* Greguss (Ipolytarnóc, Burdigalian)



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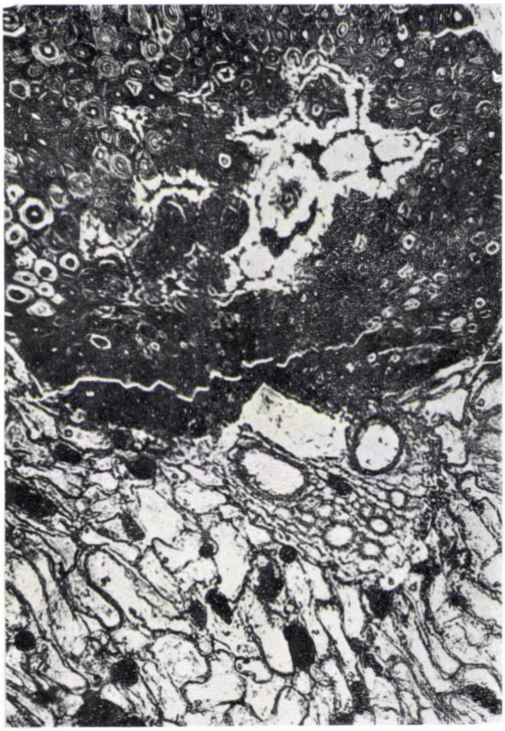

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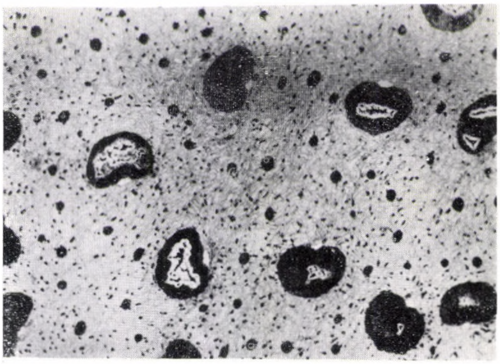

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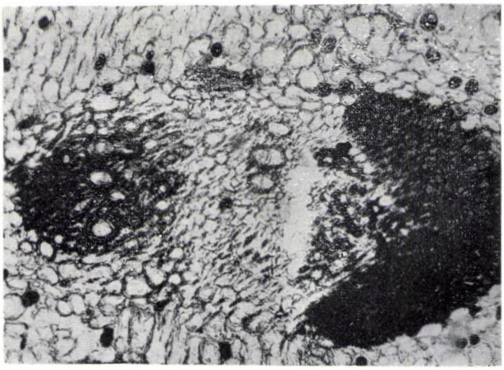

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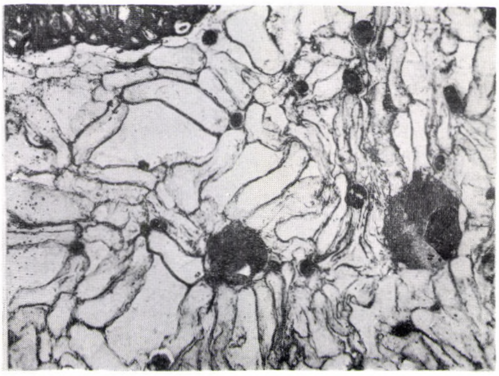

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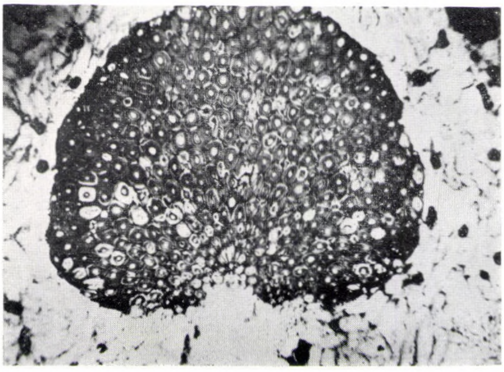

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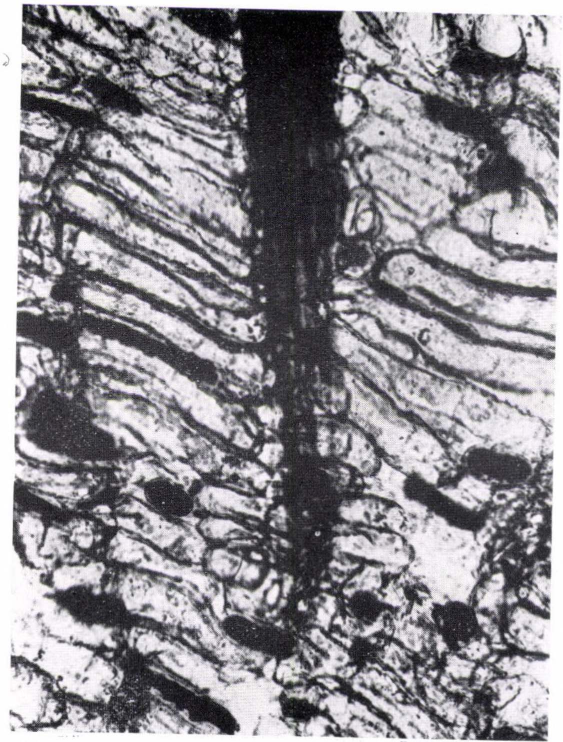
IV. 1–6. *Palmoxylon hungaricum* Greguss (Salgótarján, Helvetian)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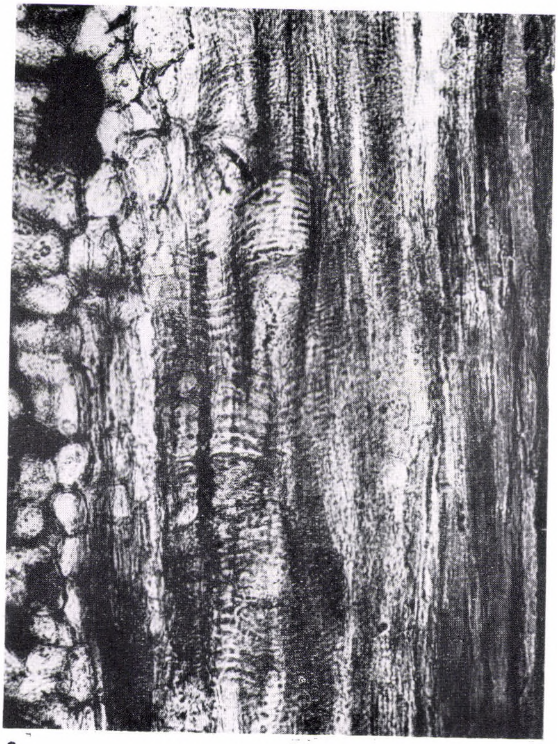
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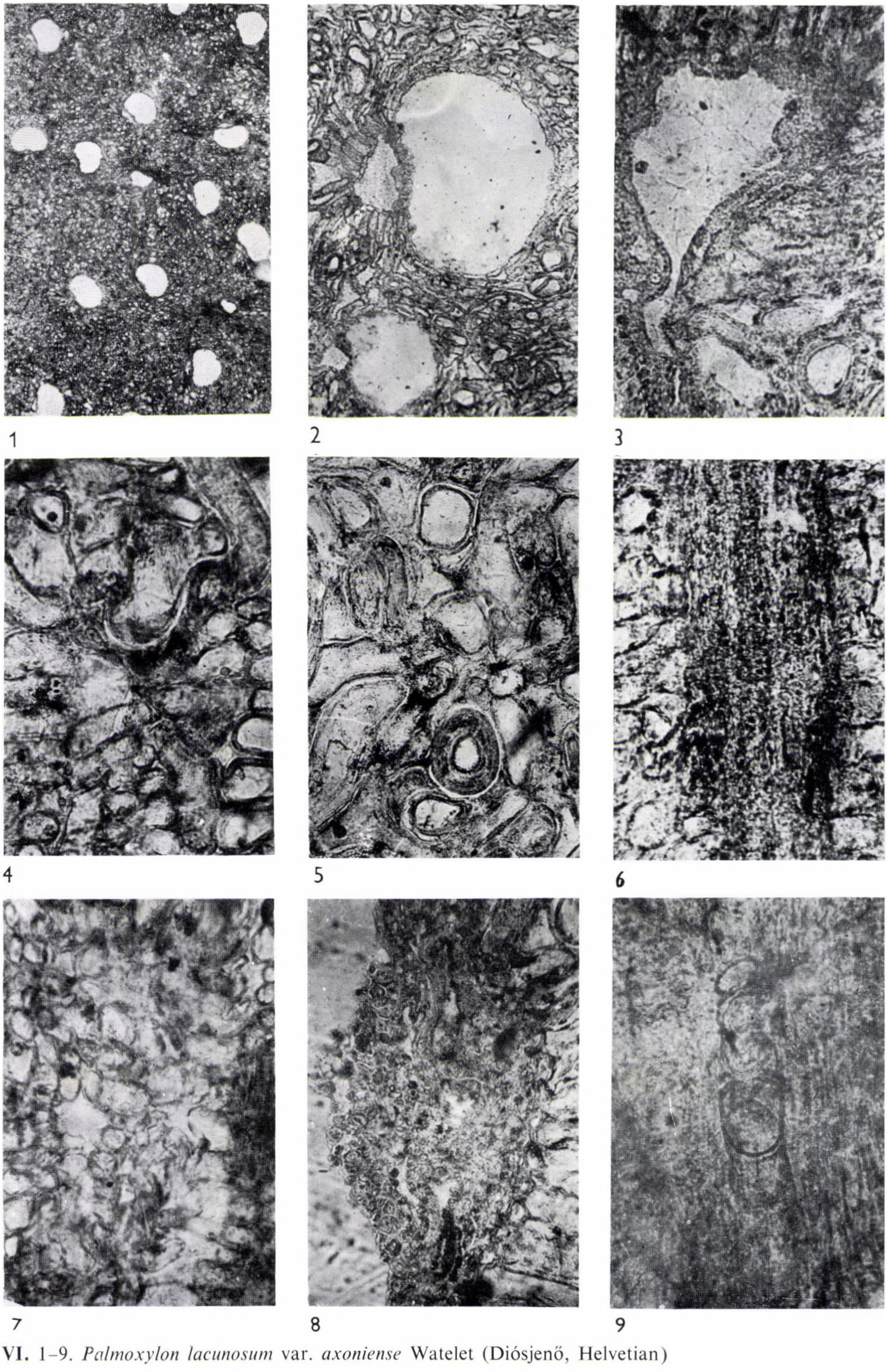
V. 7–10. *Palmoxylon hungaricum* Greguss (Salgótarján, Helvetian)



VI. 1–9. *Palmoxylon lacunosum* var. *axoniense* Watelet (Diósjenő, Helvetian)

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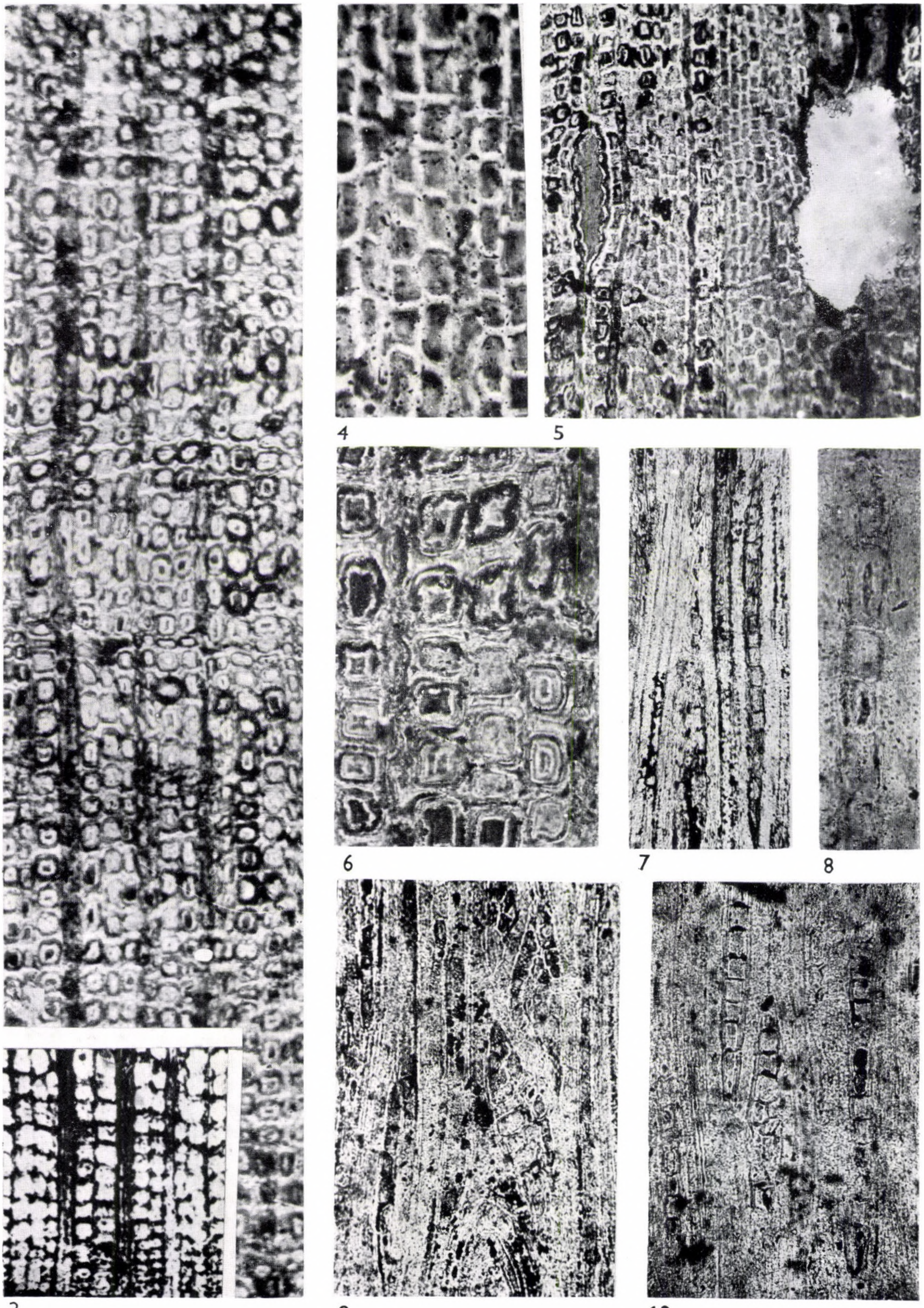
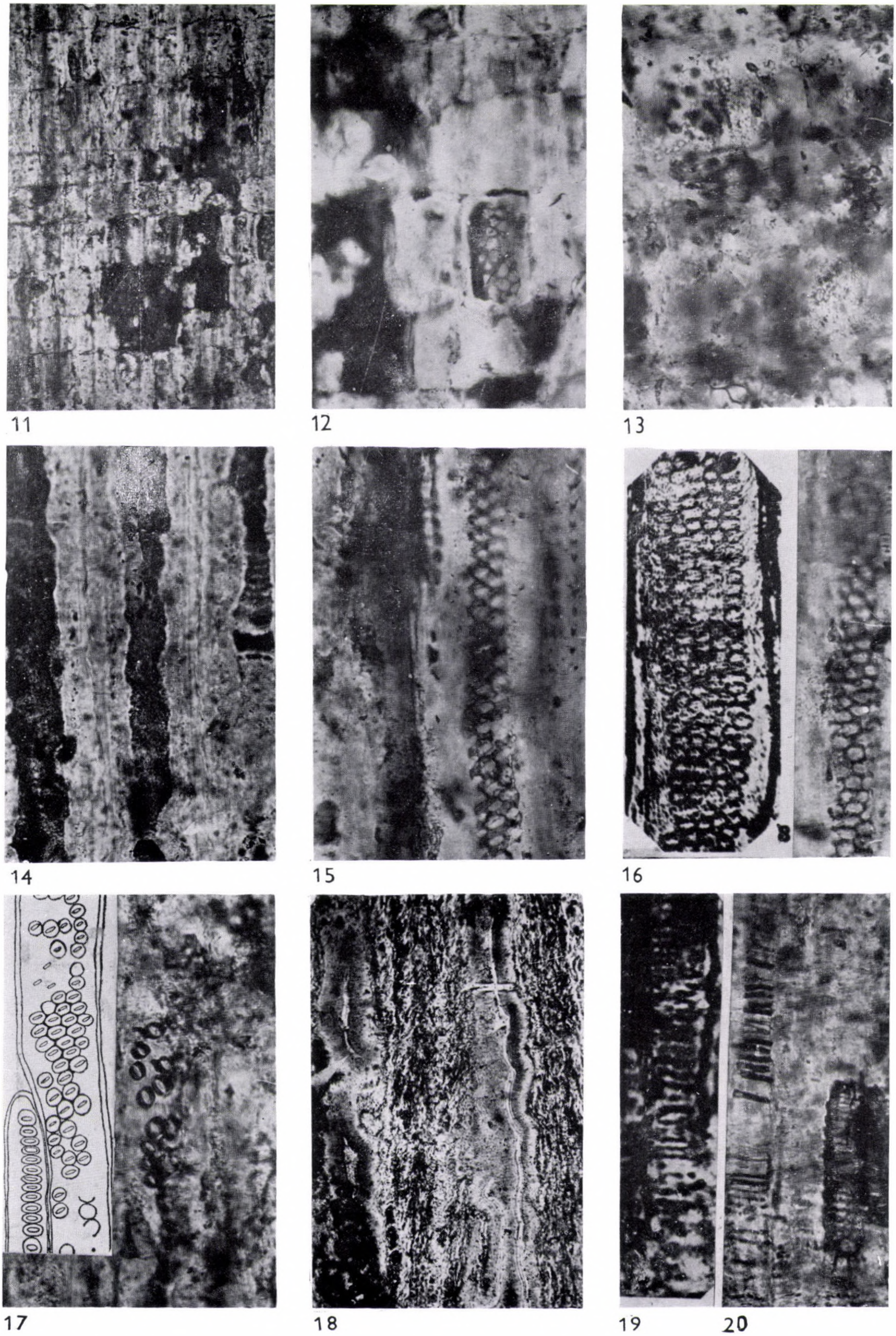
VII. 1 and 2. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian)



VIII. 3–10. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian)



IX. 11–20. *Tetracentronites hungaricum* Greguss (Tokaj, Sarmatian)

X. 1–9. *Flacourtioxylon* sp.? (*Nyssoxylon?*) (Tatabánya, Middle Eocene)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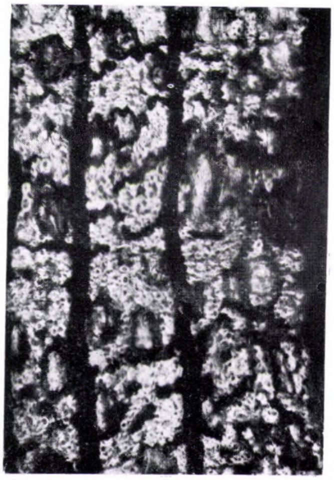
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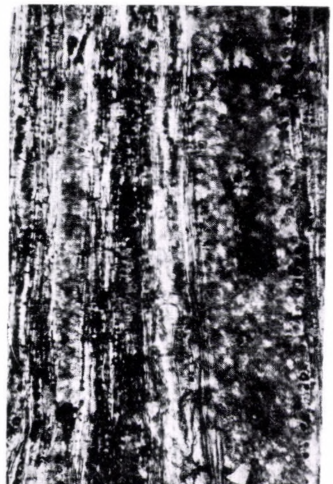
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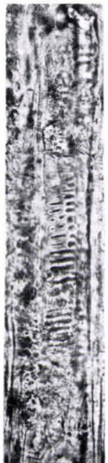
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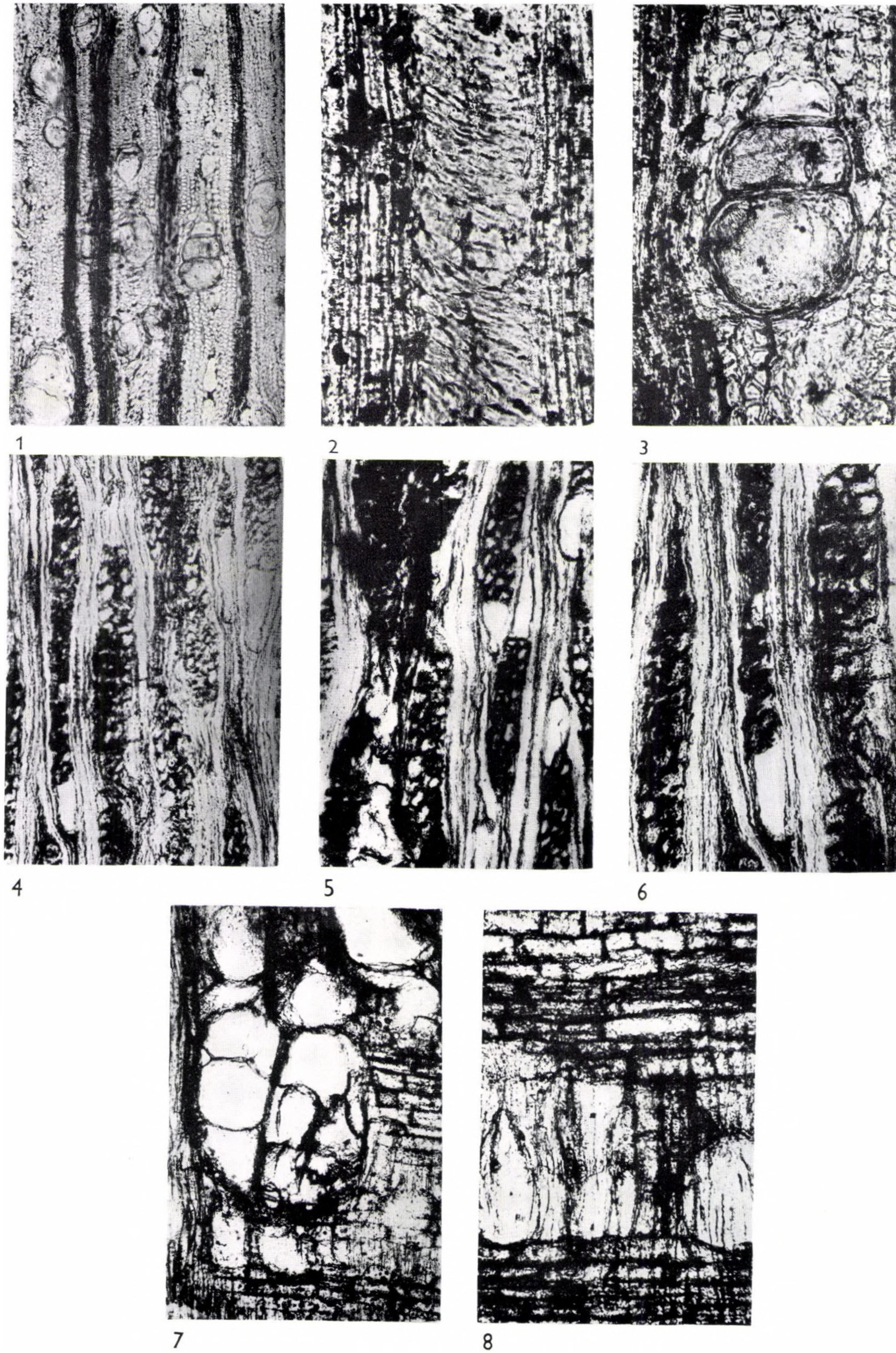
XI. 1–10. *Dillenioxylon mikófalvense* n. gen. et n. sp. (Mikófalva, Sarmatian)



XII. 1–8. *Laurinoxylon vadászi* Greguss (Hidas, Helvetian)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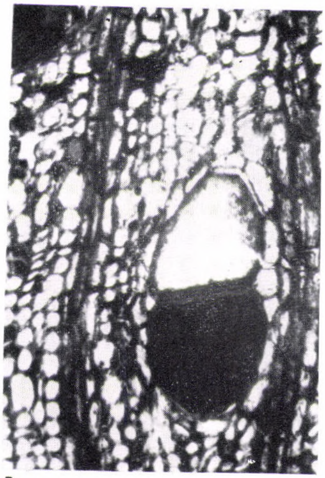
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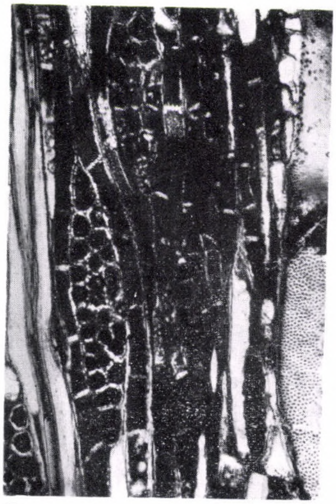
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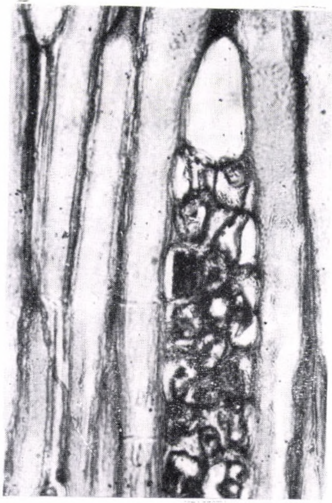
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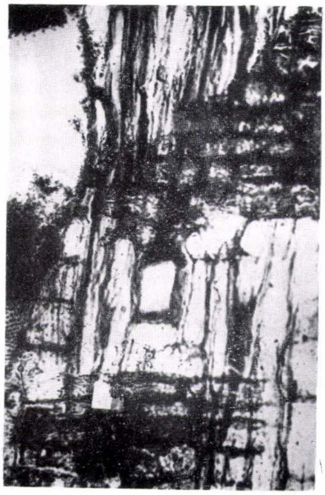
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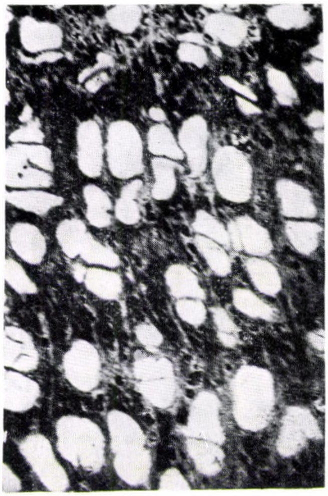
XIII. 1–9. *Laurinoxylon* cf. *hasenbergense* Süss (Salgótarján, Helvetian)



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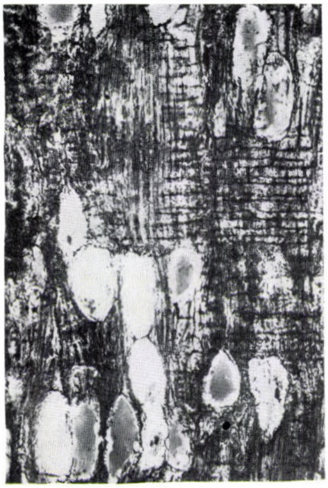

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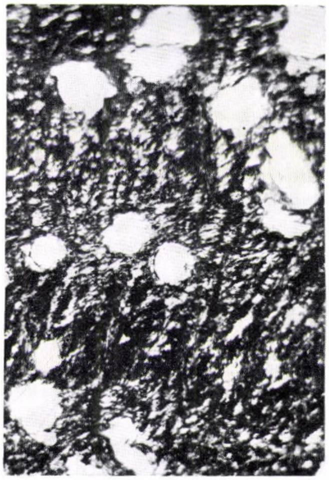

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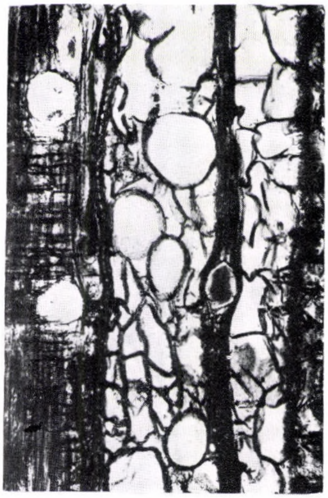

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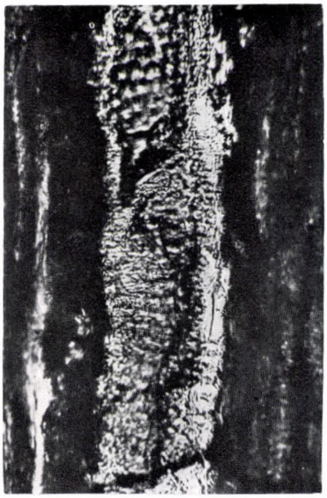

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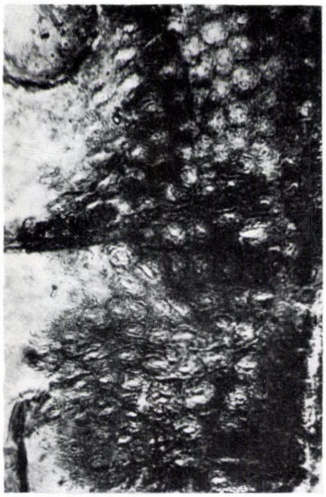

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XIV. 1–3. *Laurinoxylon aniboides* Greguss em. Süss (Ipolytarnóc, Burdigalian)
4–9. *Laurinoxylon müller-stollii* Greguss em. Süss (Ipolytarnóc, Burdigalian)

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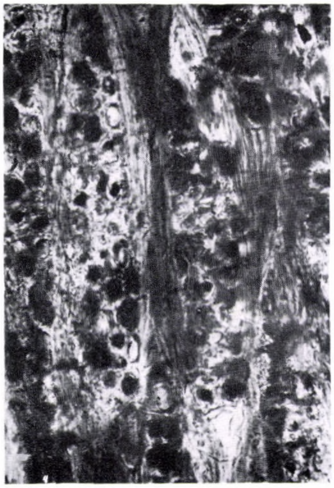

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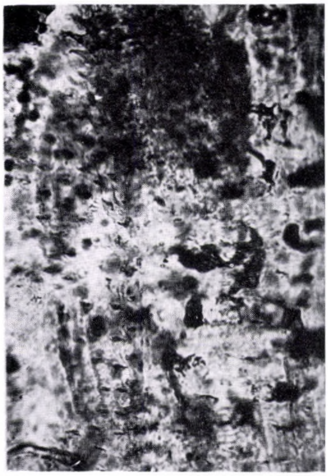

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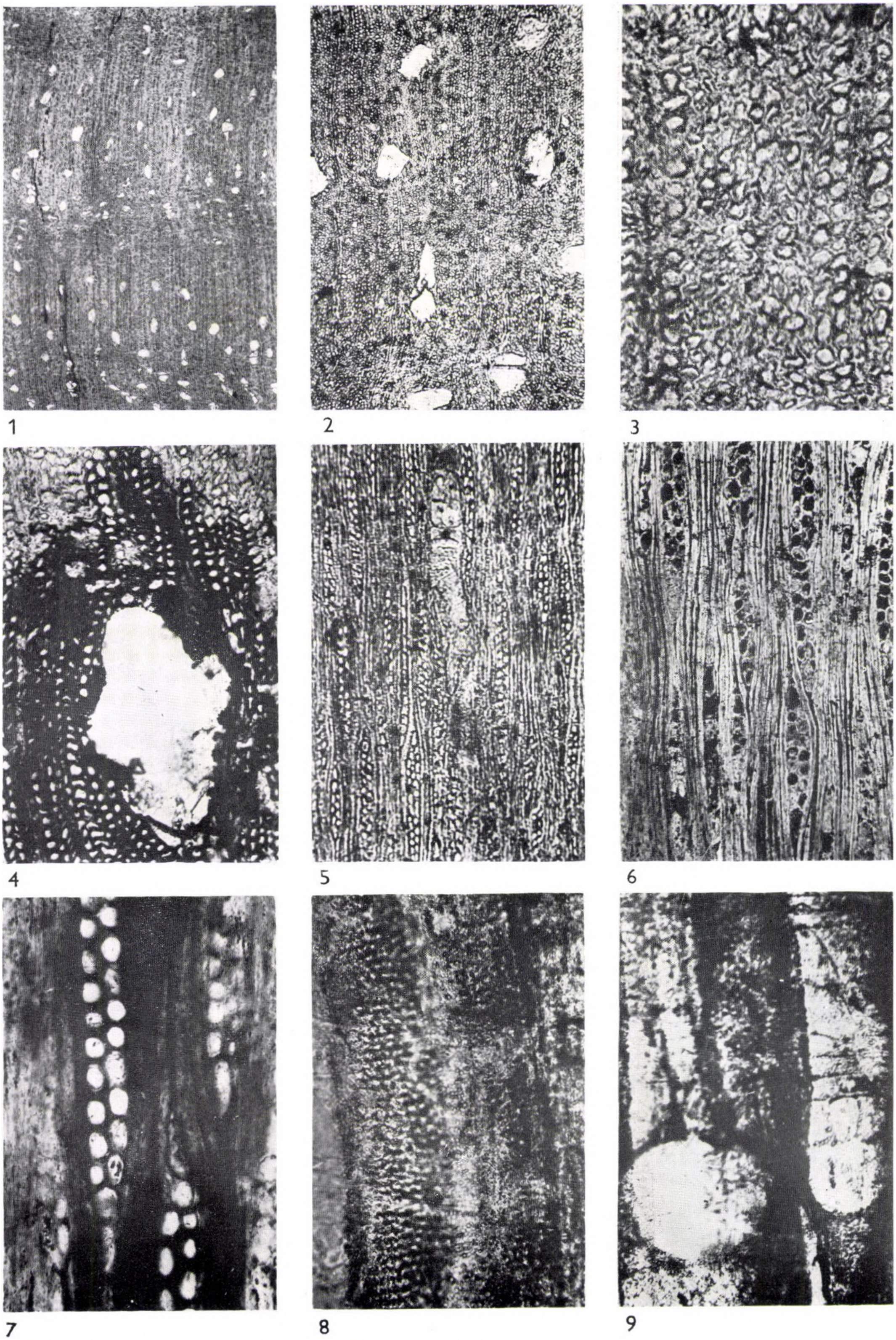
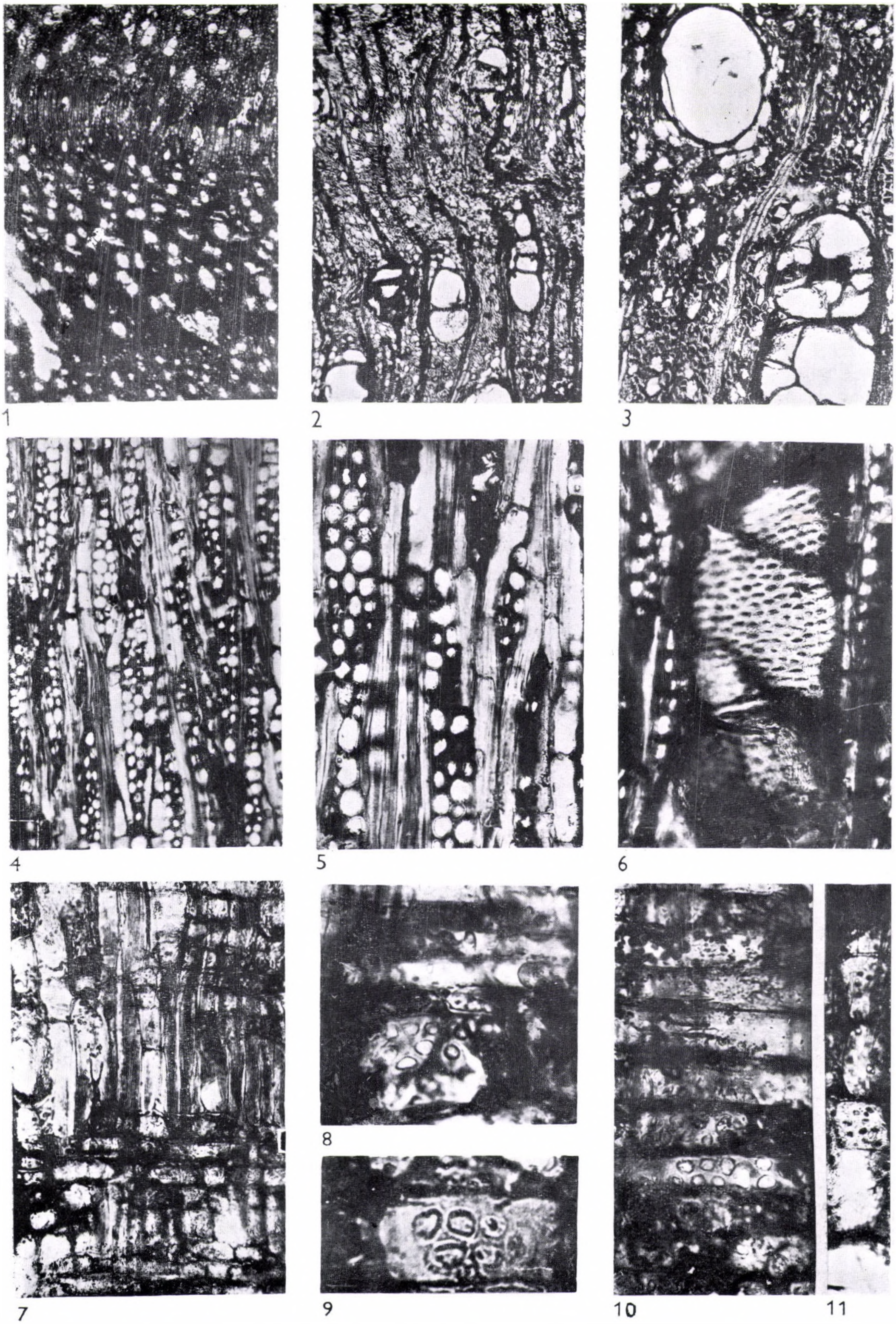
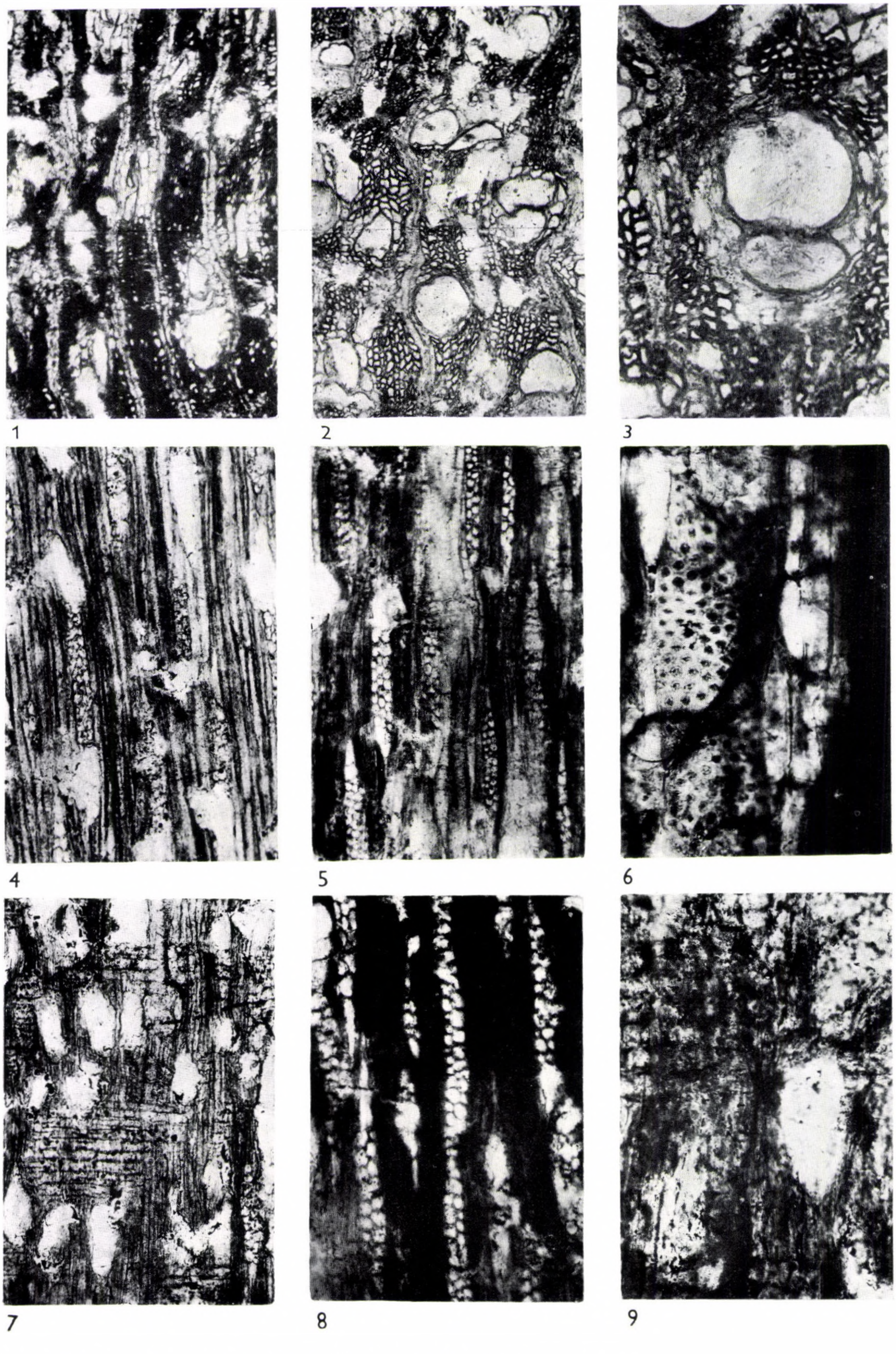
XV. 1–8. *Laurinoxylon* cf. *californicum* (Platen) Süss (Zagyvapálfalva, Lower Helvetian)



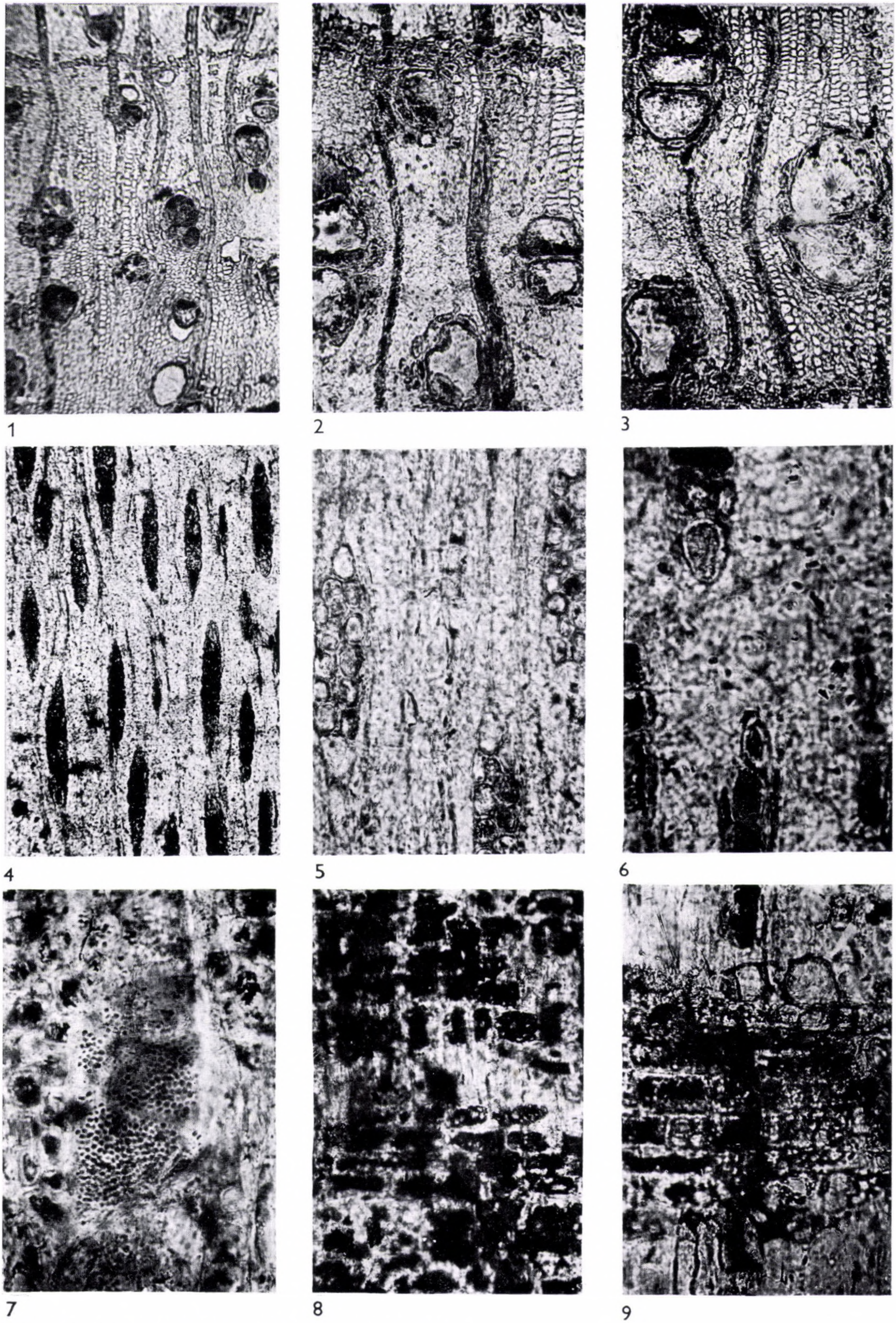
XVI. 1–9. *Laurinoxylon pálfalvyi* n. sp. (Becske, Burdigalian)



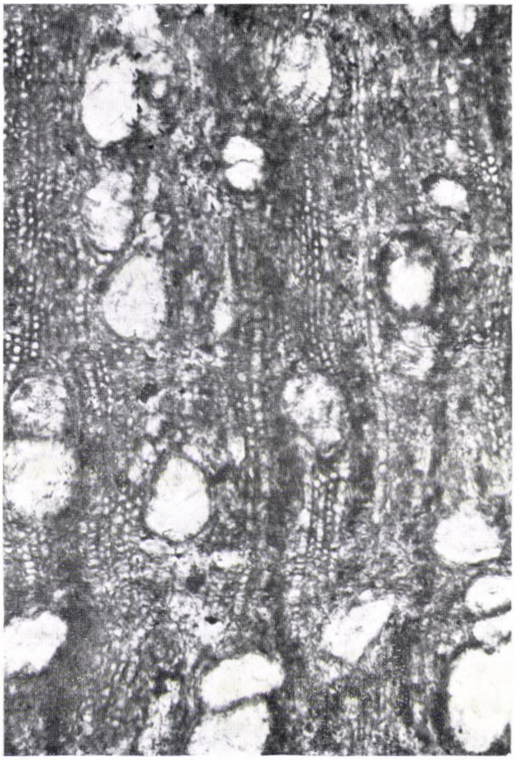
XVII. 1–11. *Laurinoxylon daberi* n. sp. (Jobbágyi, Tortonian)



XVIII. 1–7. *Laurinoxylon süssi* n. sp. (Szokolya, Helvetian)
8 and 9. *? Cinnamomoxylon* sp. (No. 2) (Mogyoród, Helvetian)



XIX. 1–9. *? Laurinoxylon* sp. (Apátvarasd, Helvetian)



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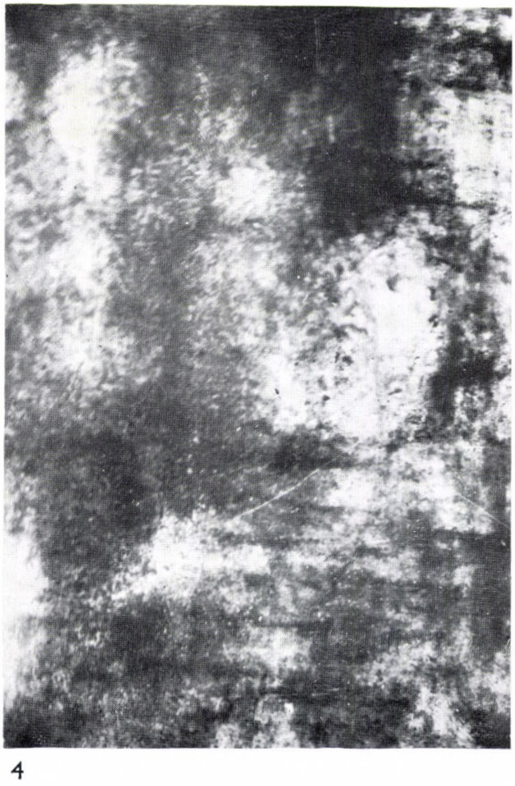

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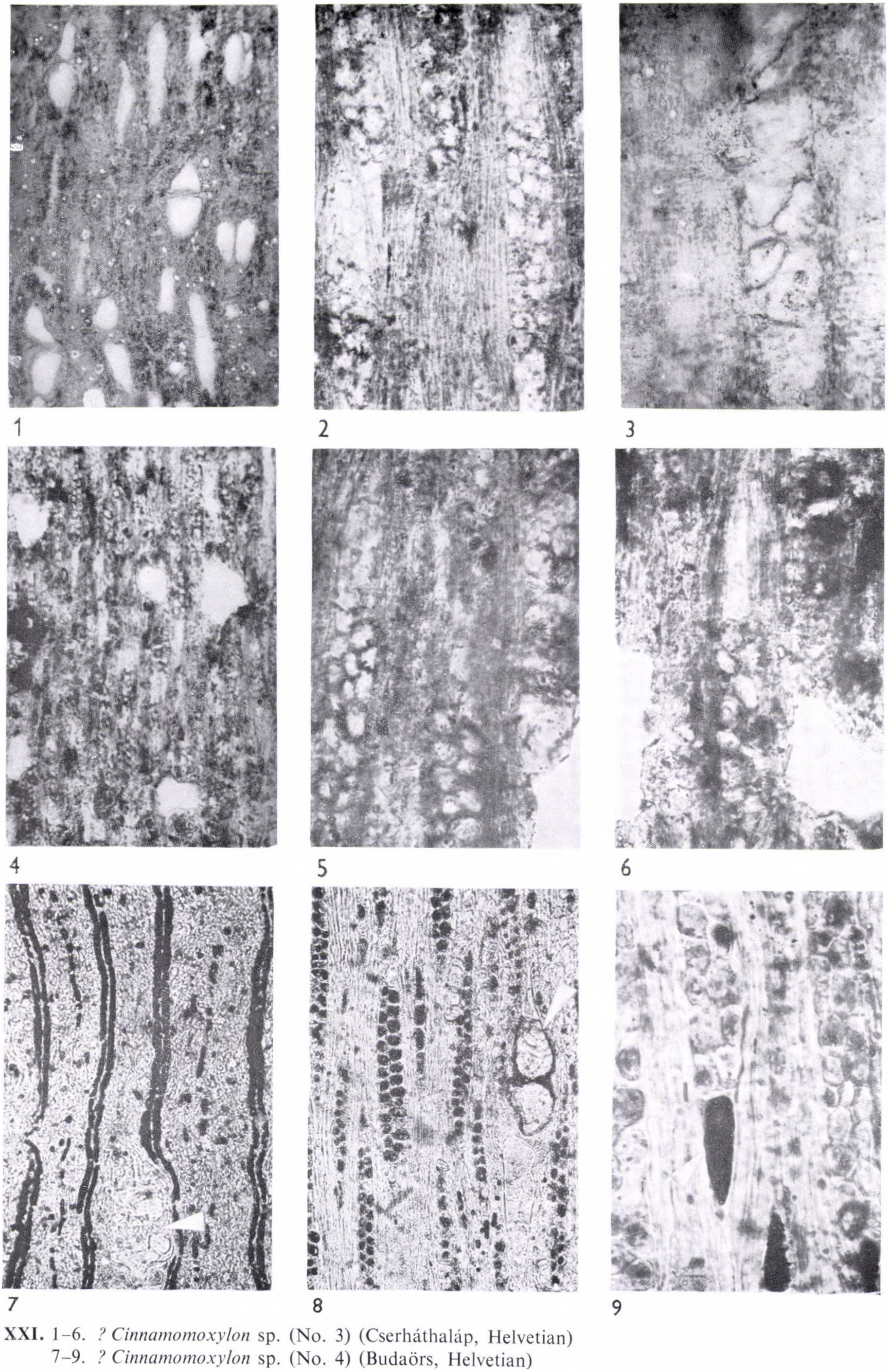
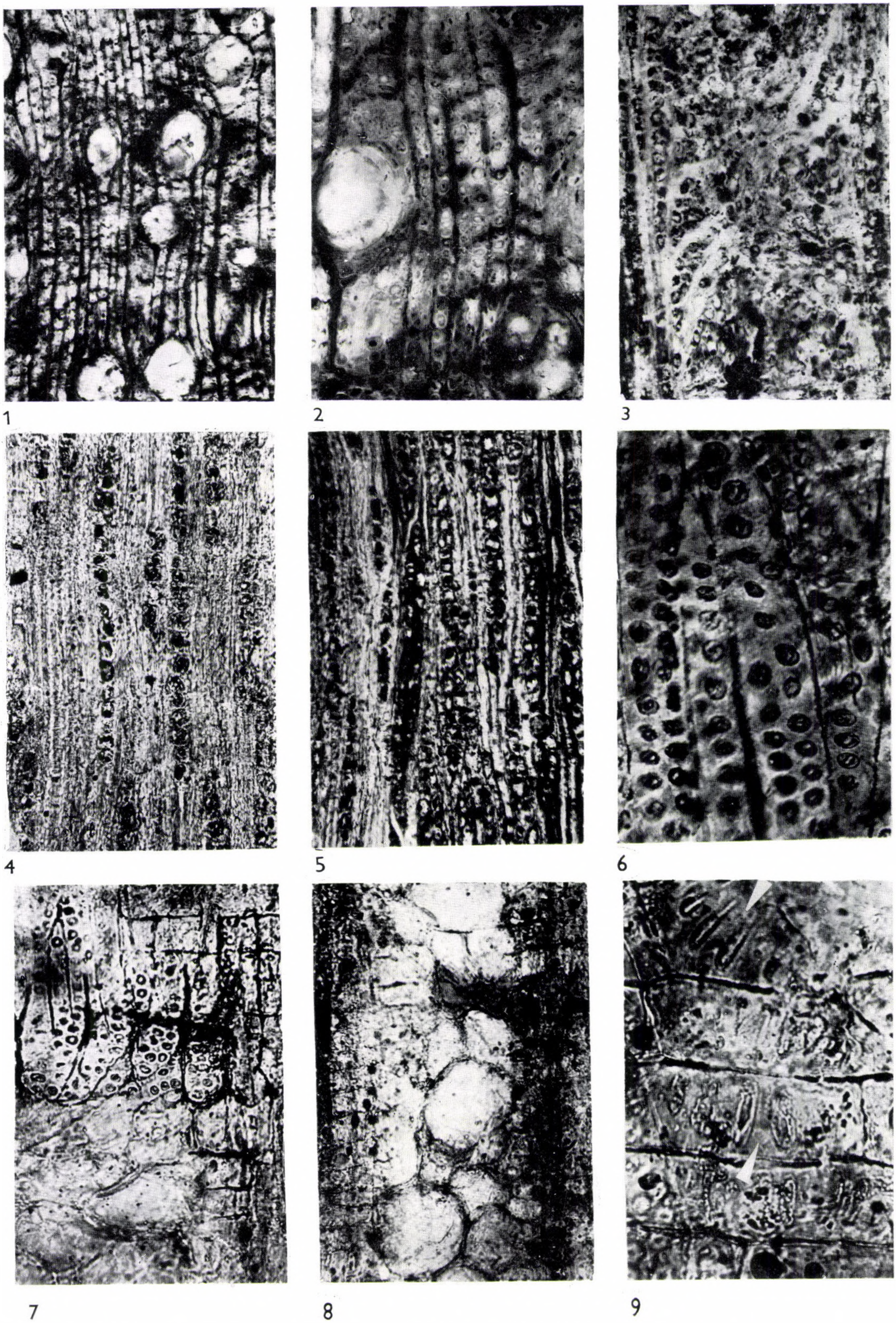
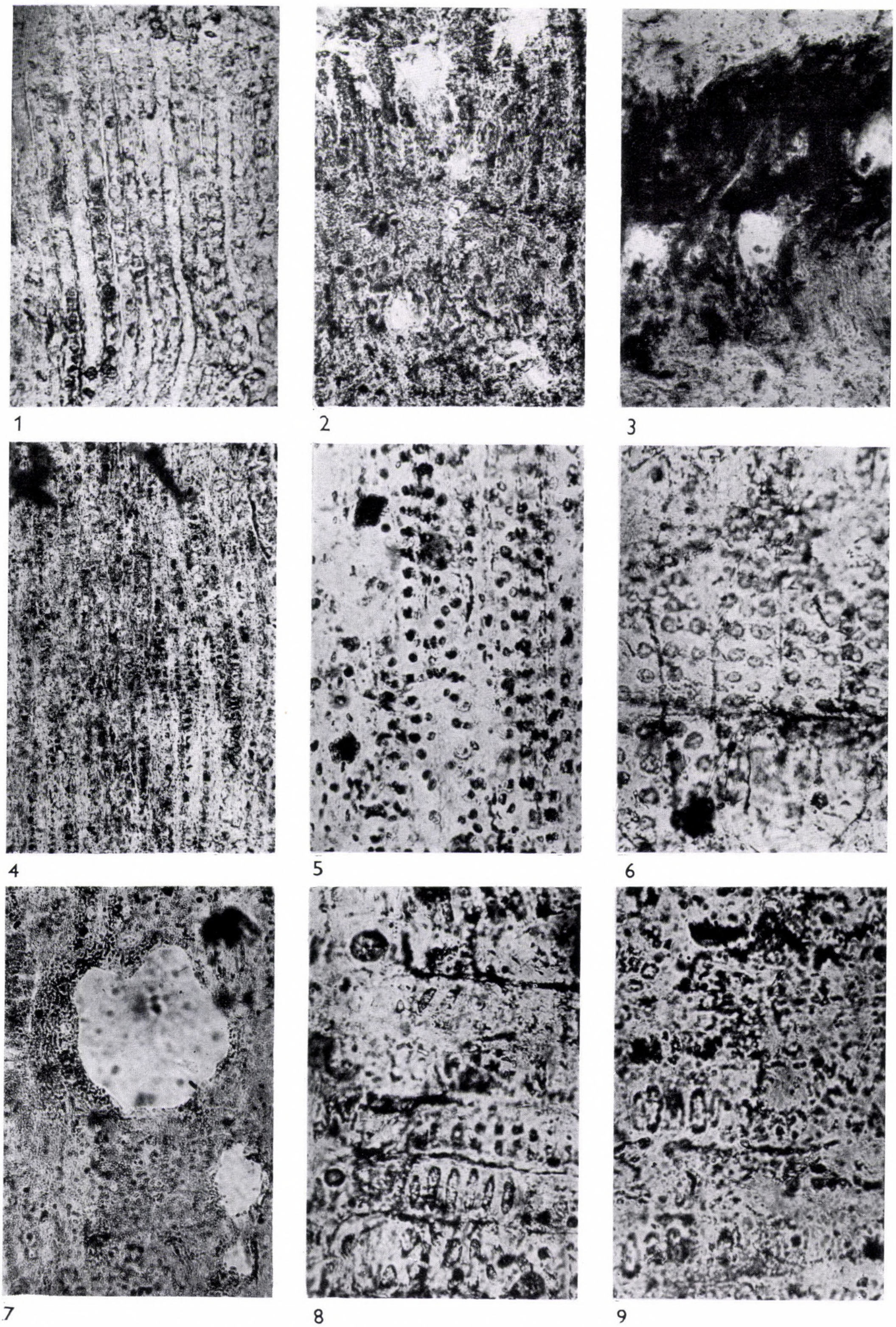
XX. 1–4. *? Cinnamomoxylon* sp. (No. 1) (Dorog, Oligocene)



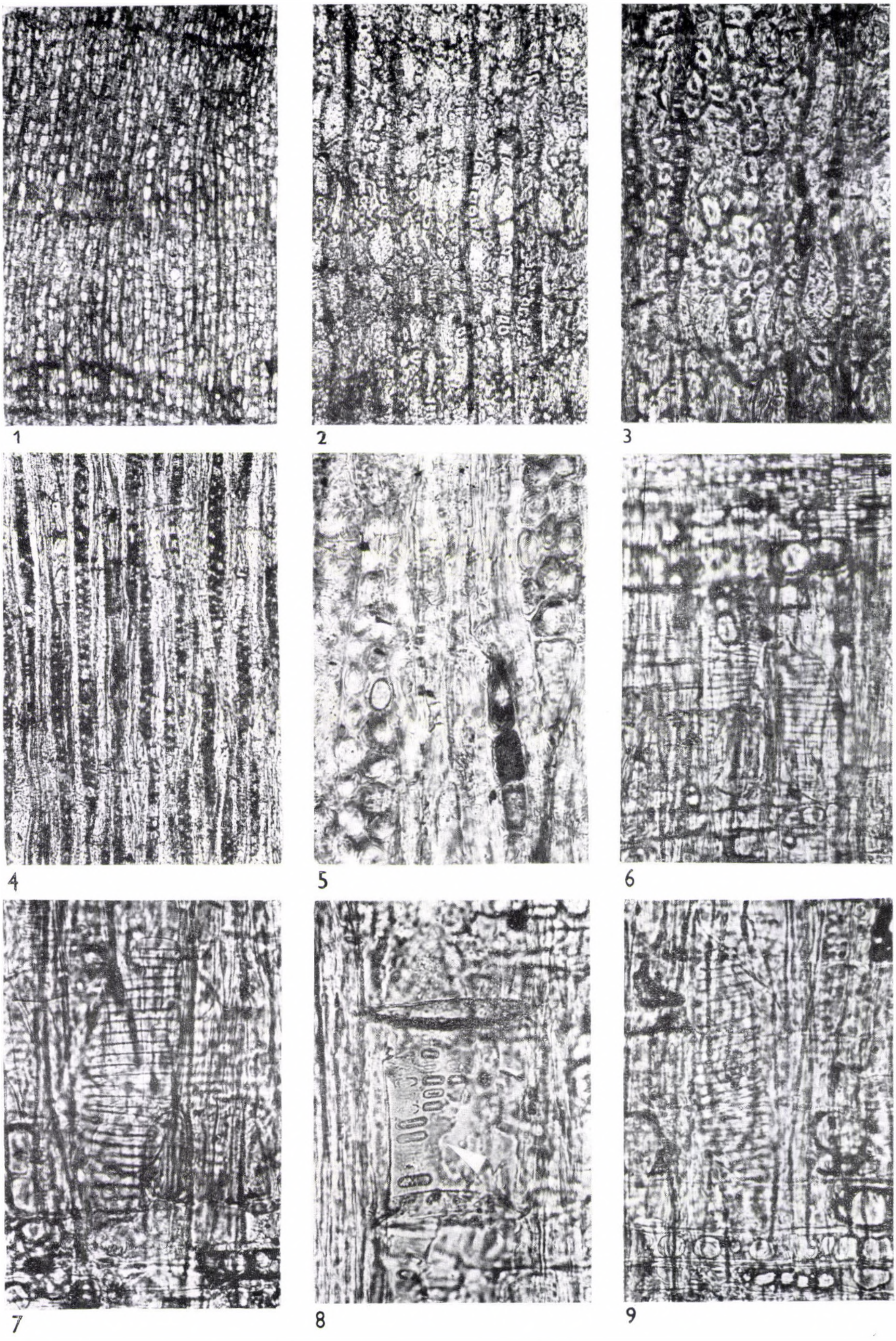
XXI. 1–6. ? *Cinnamomoxylon* sp. (No. 3) (Cserháthaláp, Helvetian)
7–9. ? *Cinnamomoxylon* sp. (No. 4) (Budaörs, Helvetian)



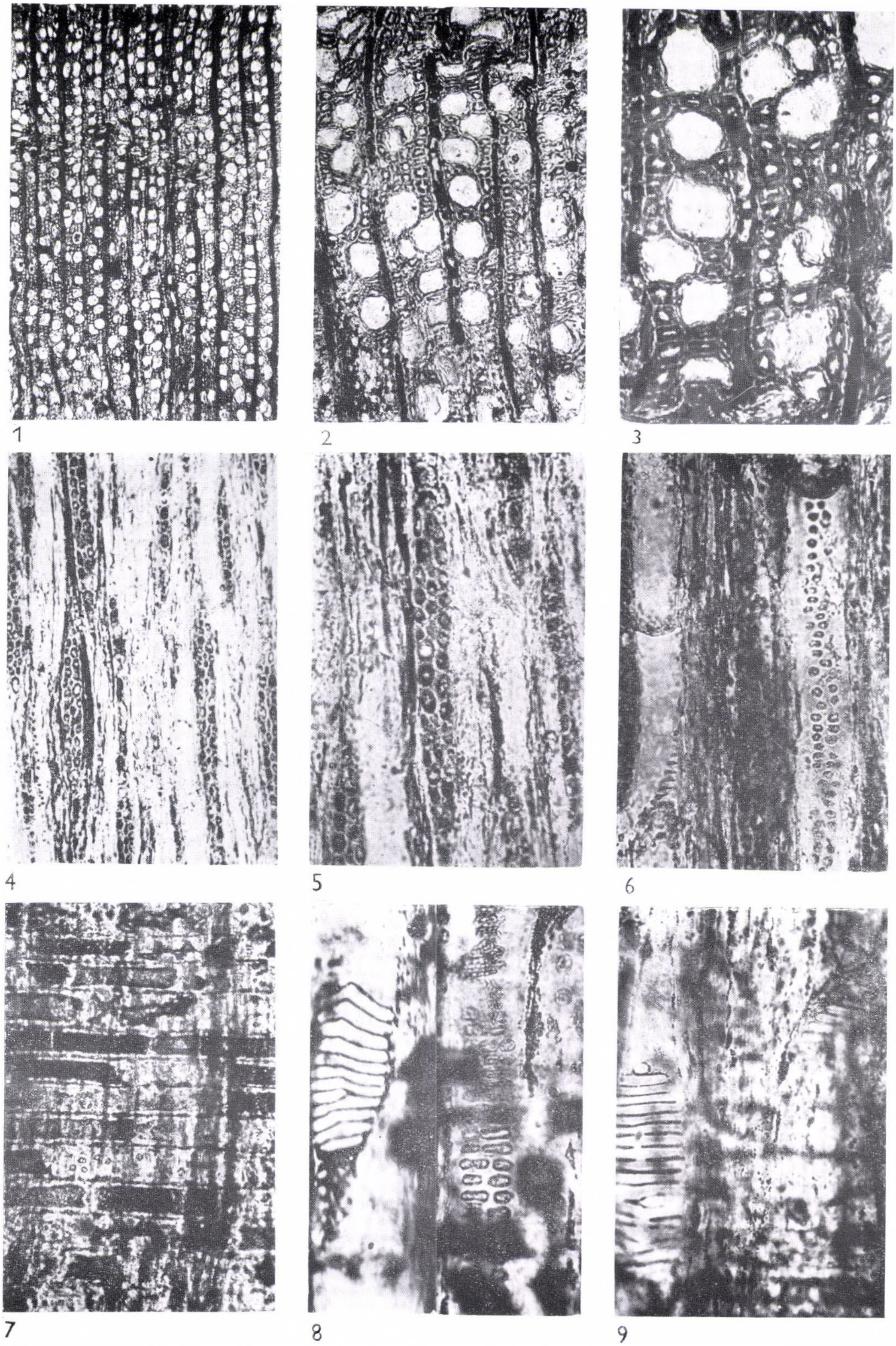
XXII. 1–9. *Myristicoxylon hungaricum* n. sp. (Budakalász, Lower Oligocene)



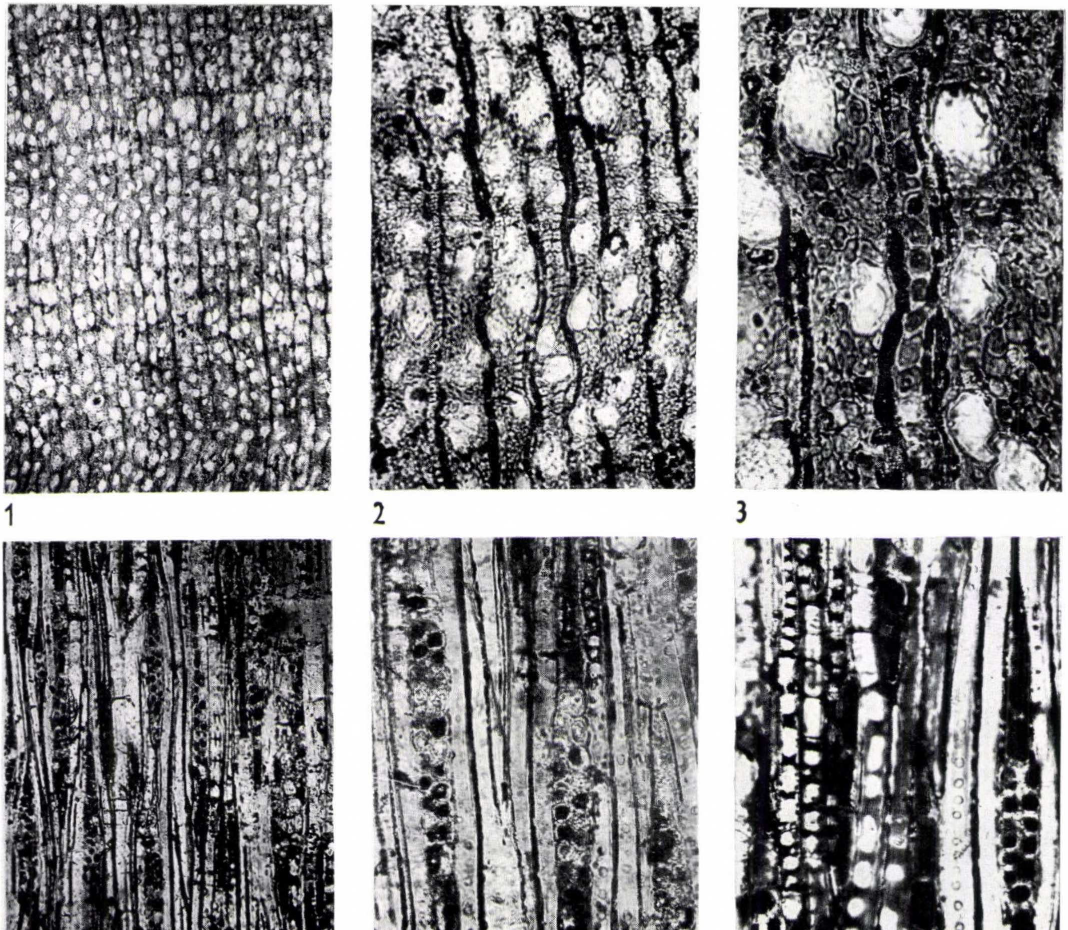
XXIII. 1–9. *Myristicoxylon bajnaense* n. sp. (Bajna, Oligocene)



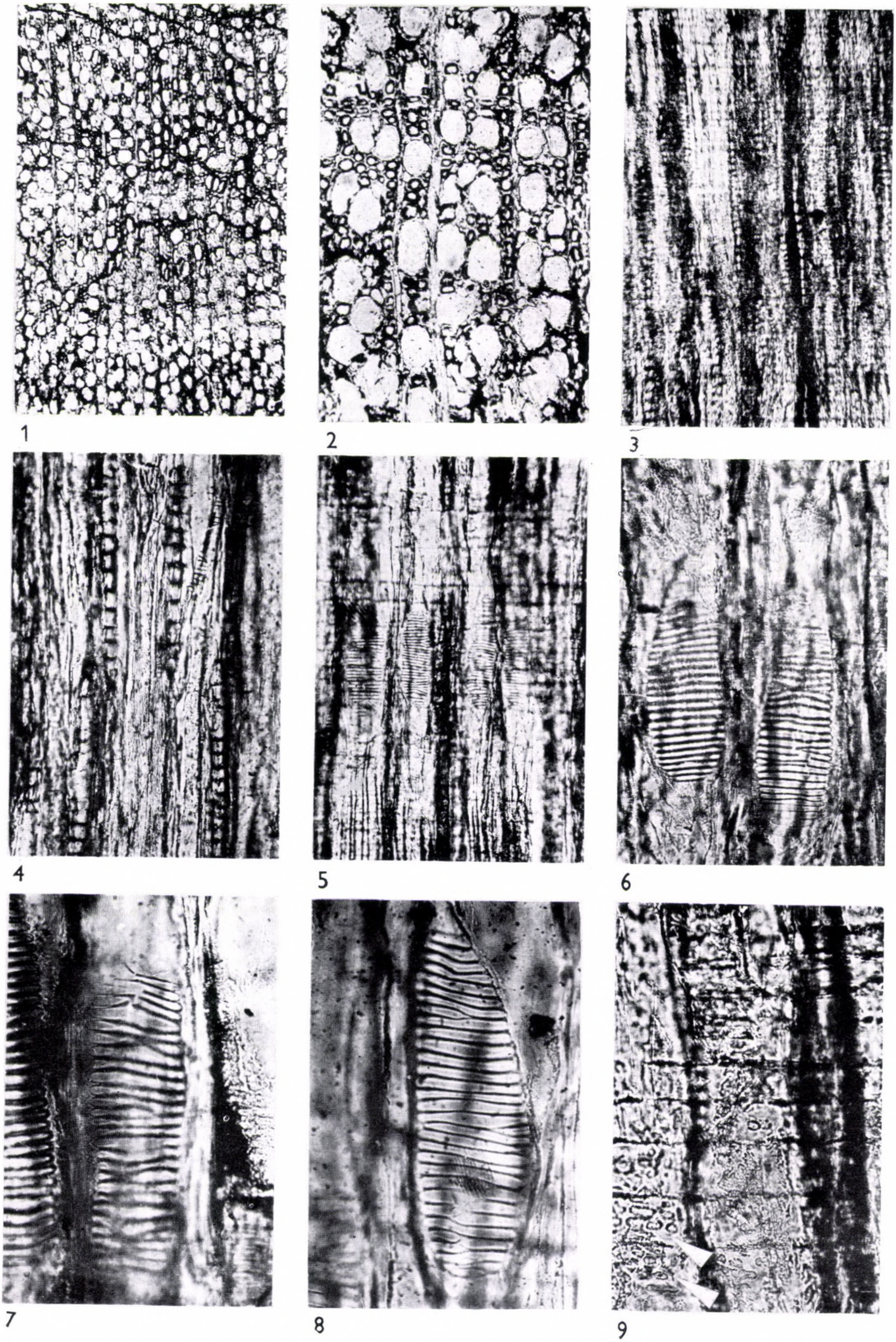
XXIV. 1–9. *Liquidambaroxylon weylandi* n. sp. (Szécsény, Helvetian)



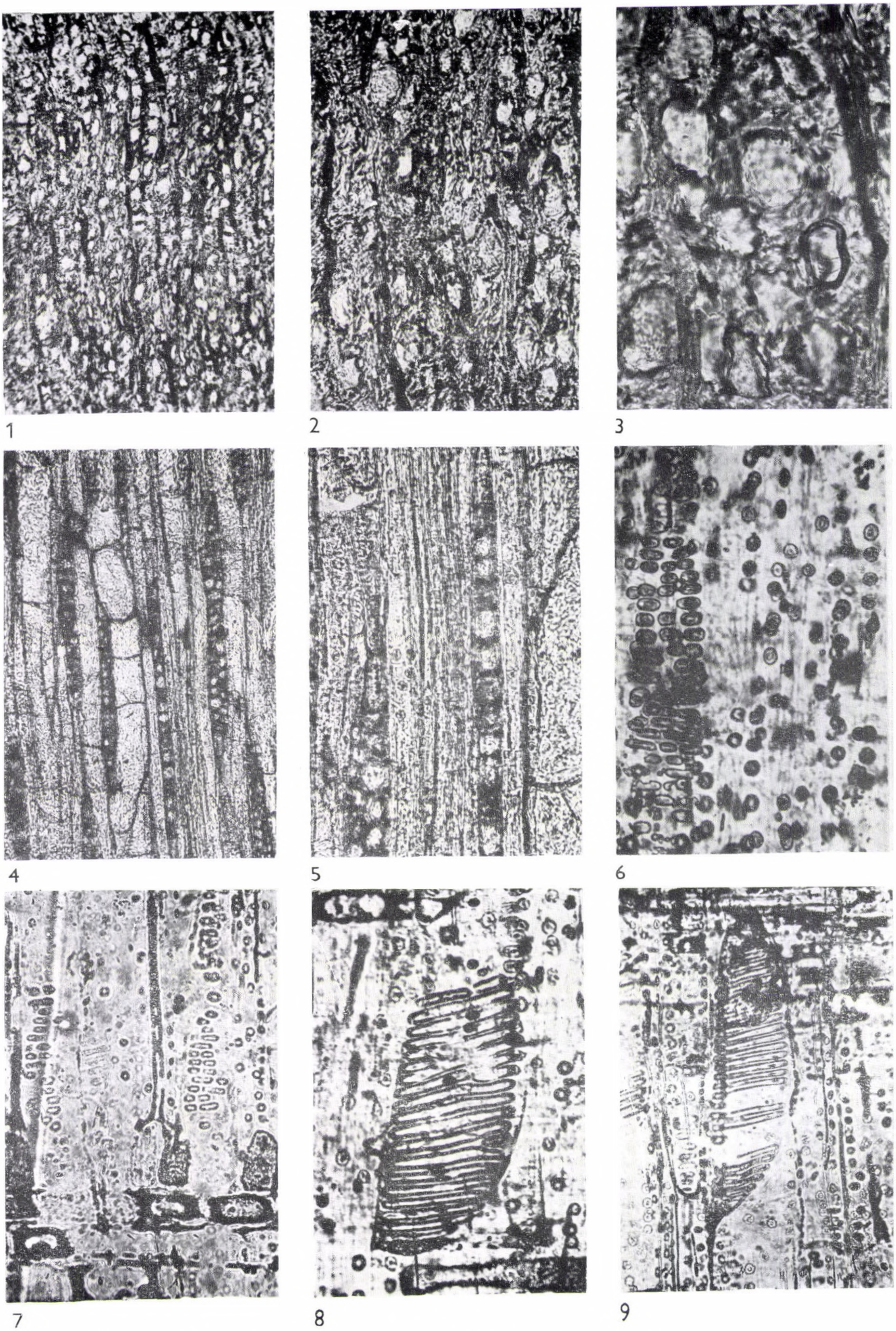
XXV. 1–9. *Liquidambaroxylon horváthi* n. sp. (Kárász, Helvetian)



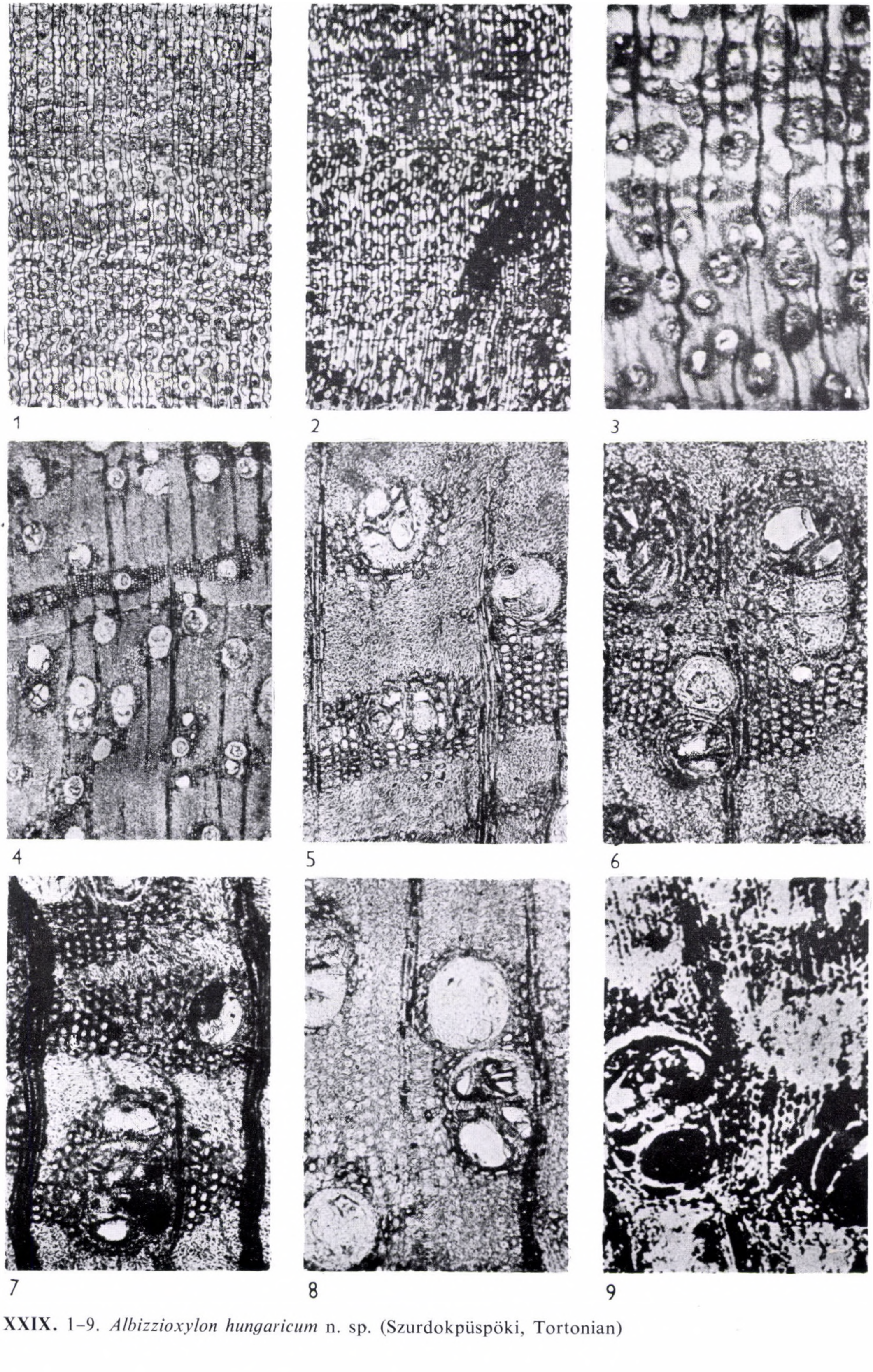
XXVI. 1–9. *Liquidambaroxylon kräuseli* n. sp. (Nógrádszakál, Sarmatian)



XXVII. 1–9. *Liquidambaroxylon mägdefraui* n. sp. (Szarvaskő, Helvetian)



XXVIII. 1–9. *Liquidambaroxylon* cf. *speciosum* Félix (Nagyvisnyó, Helvetian)



XXIX. 1–9. *Albizzioxylon hungaricum* n. sp. (Szurdokpüspöki, Tortonian)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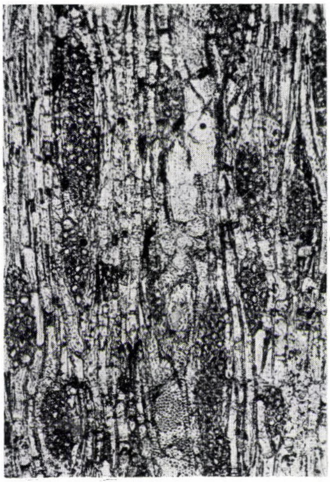
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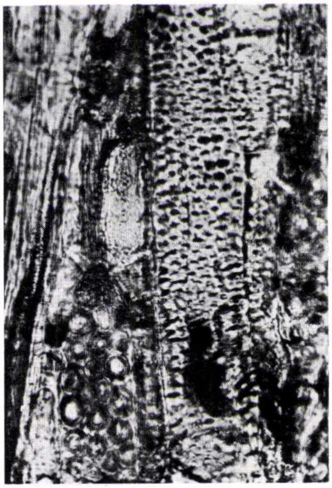
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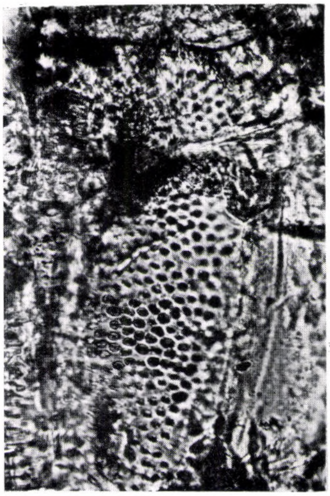
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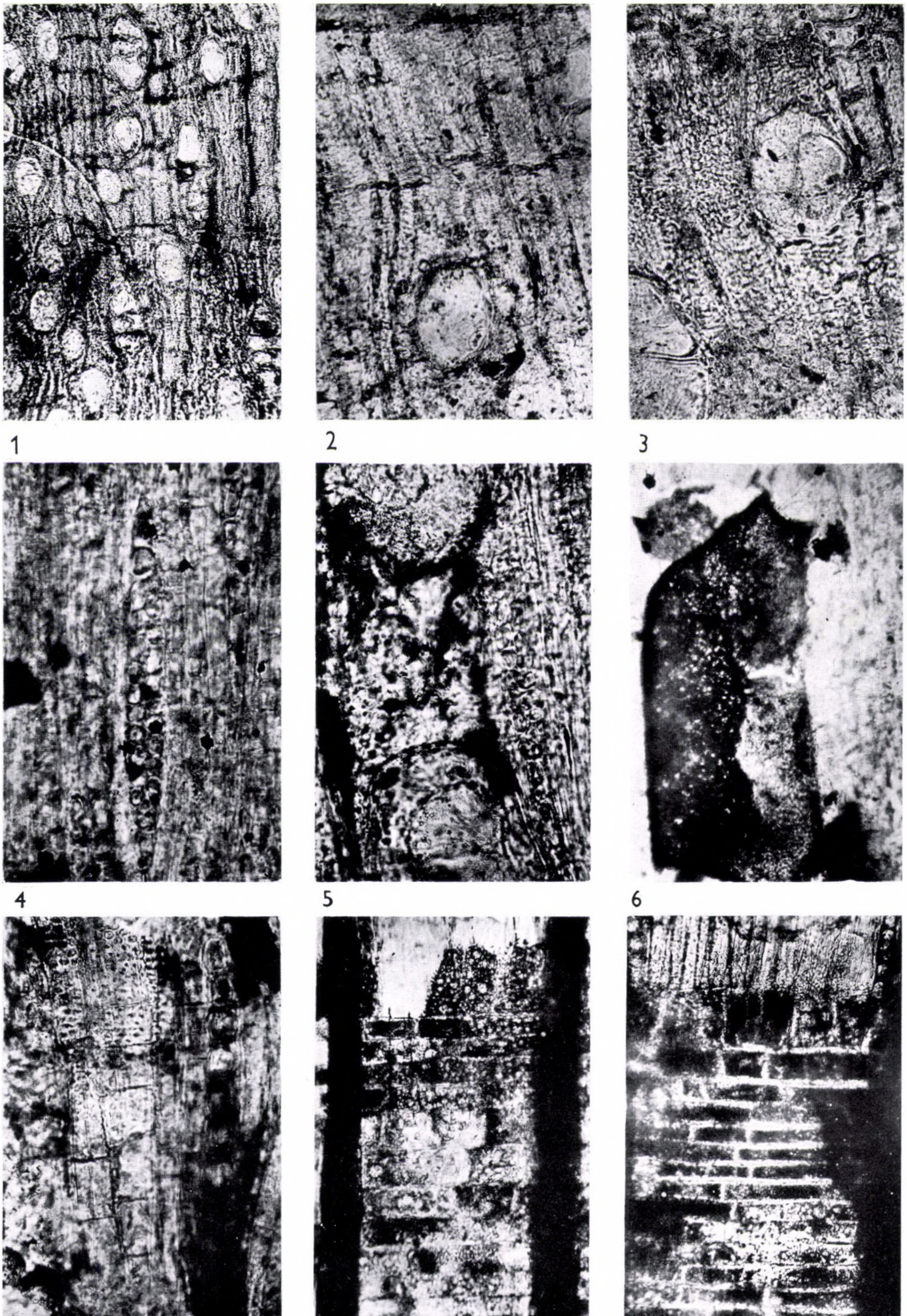
XXX. 10–18. *Albizzioxylon hungaricum* n. sp. (Szurdokpüspöki, Tortonian)



XXXI. 1–9. *Shoreoxylon pénzesi* n. sp. (Budafok, Helvetian)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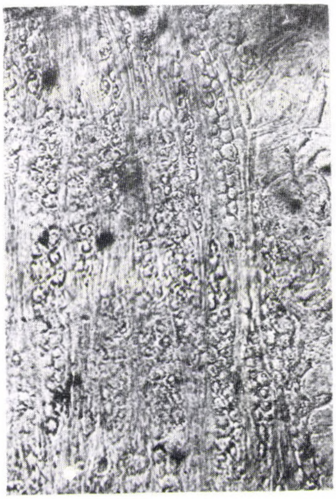
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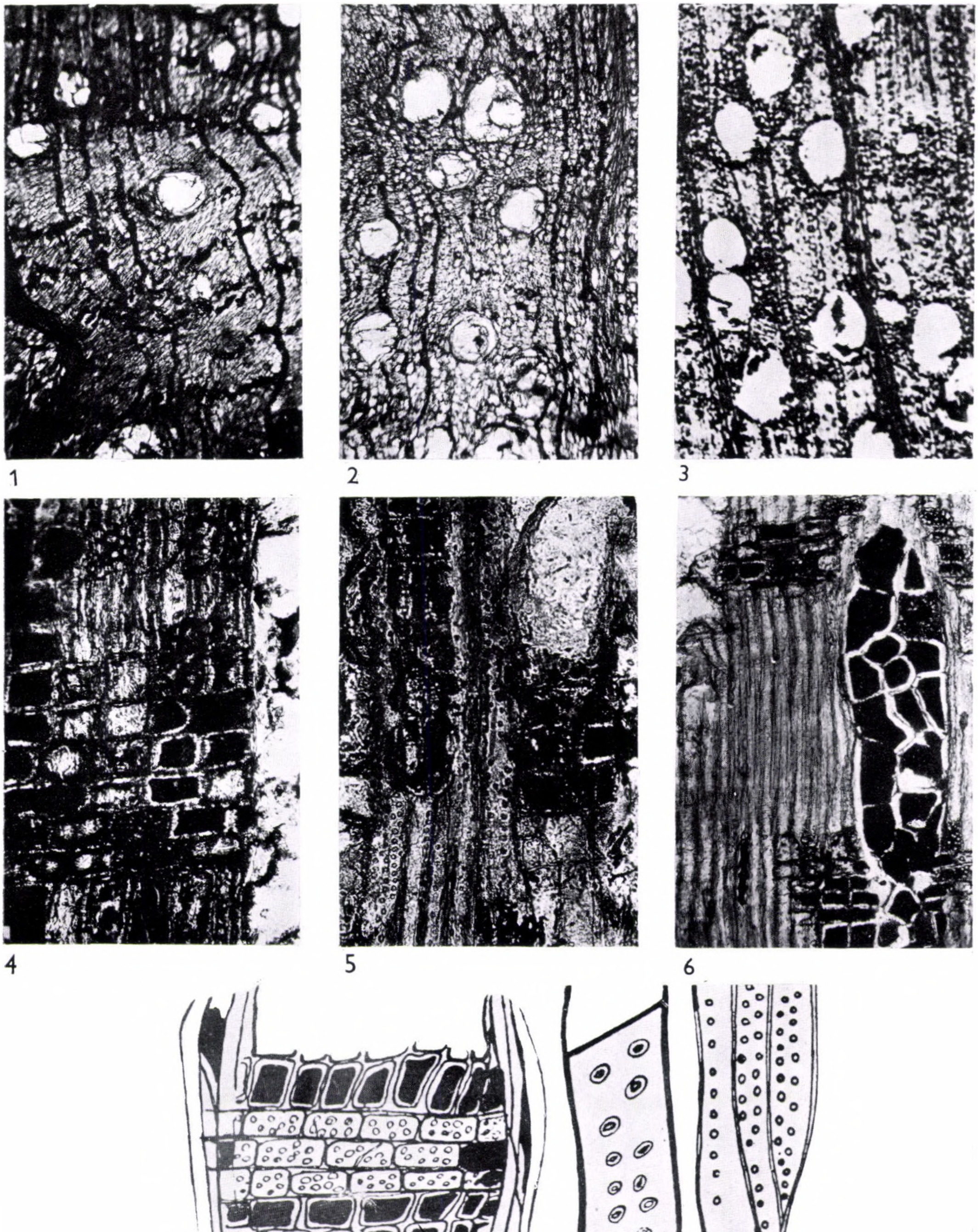
XXXII. 1–9. *Shoreoxylon* sp. (Rudabánya, Pannonian)



XXXIII. 1–7. *Shoreoxylon* cf. *holdeni* Ramanujam (Tatabánya, Eocene)

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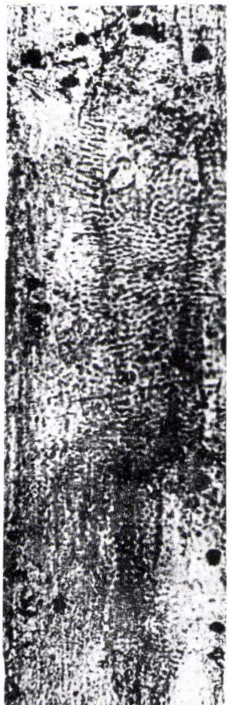

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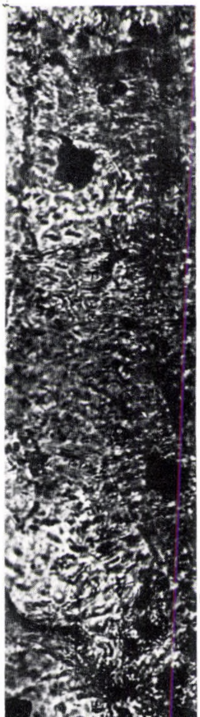

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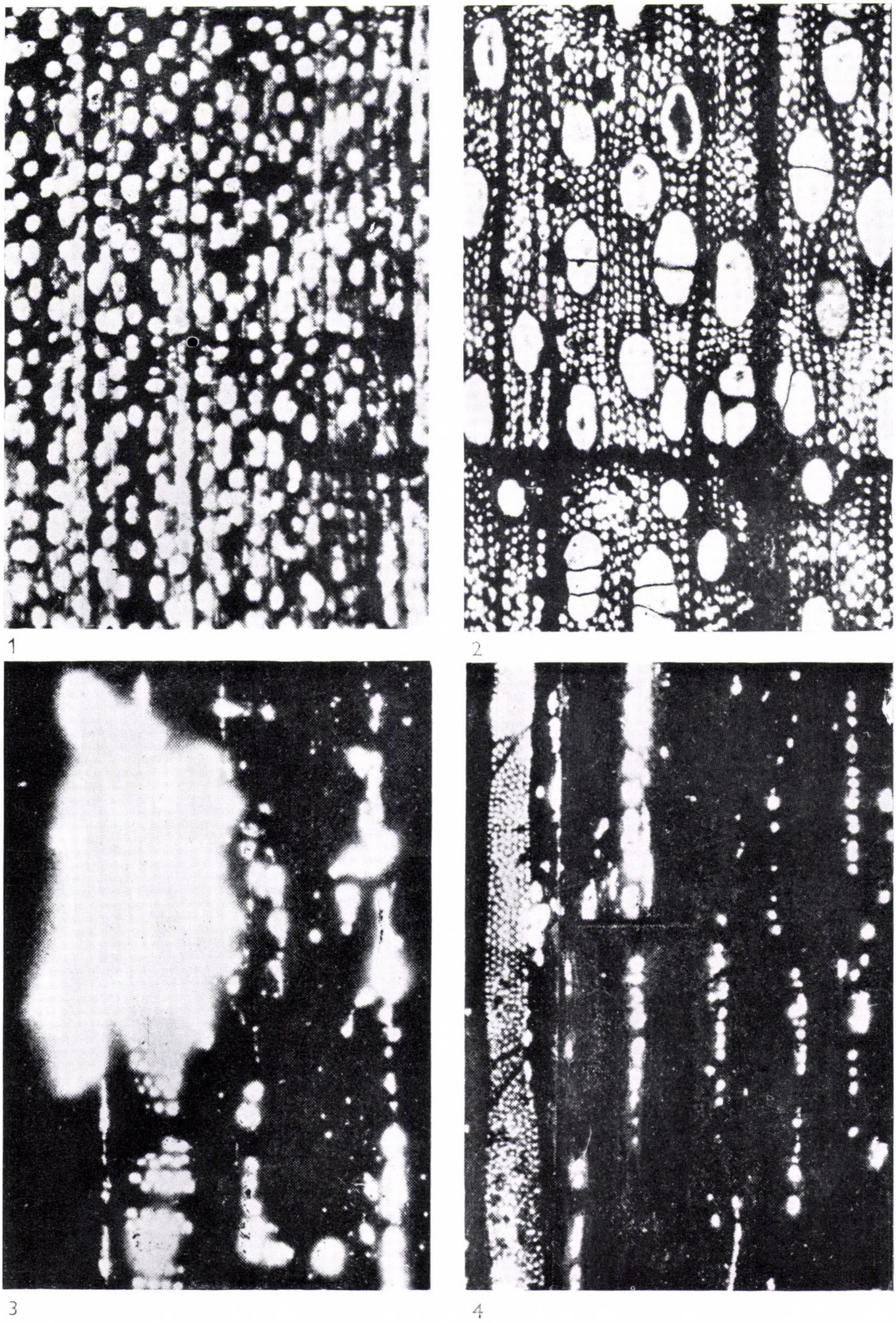
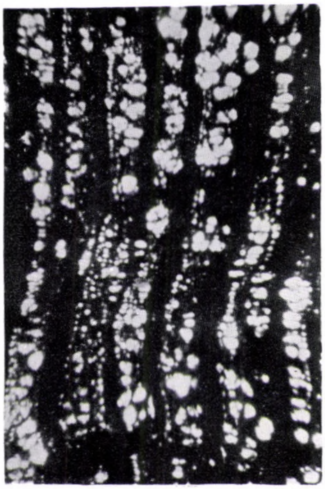
XXXIV. 1–6. *Sterculioxylon* sp.? (Dorog, Oligocene)



XXXV. 1–4. *Aceroxylon* cf. *palaeosaccharinum* Greguss (Füzérkomlós, Sarmatian)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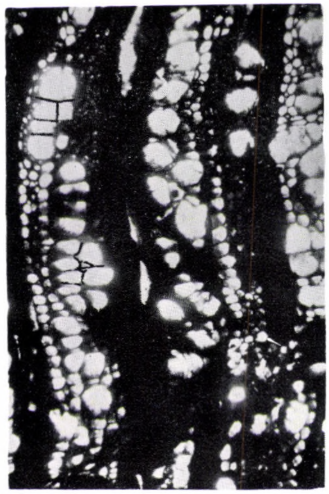
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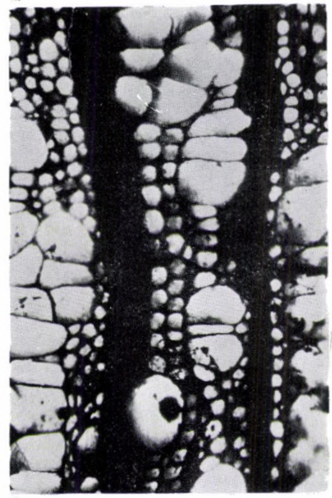
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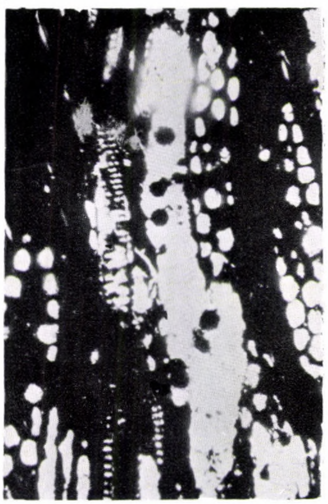
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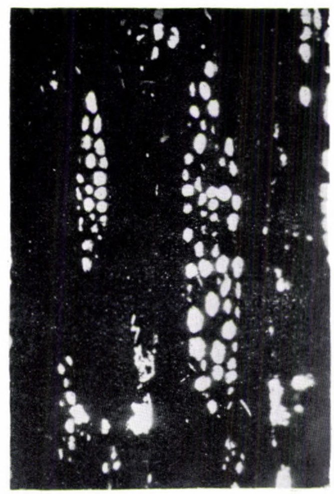
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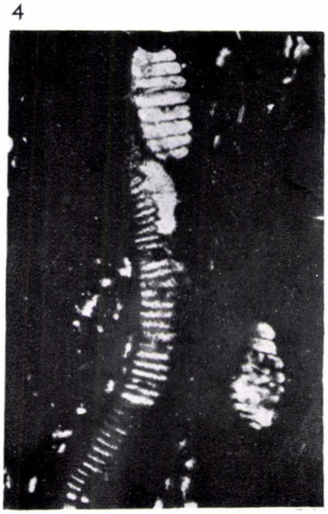
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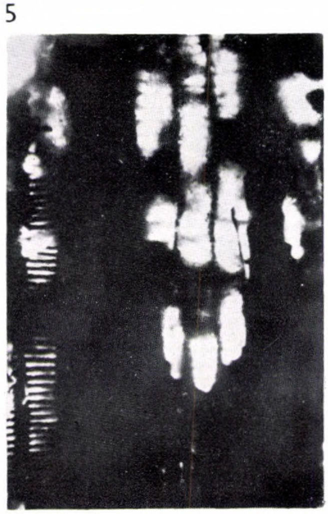
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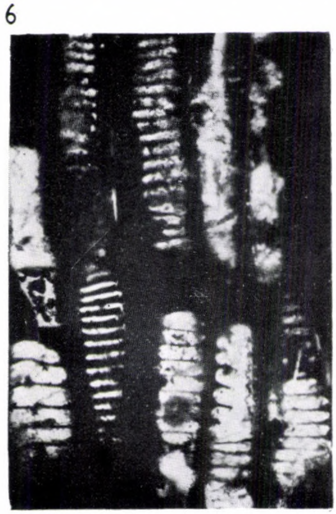
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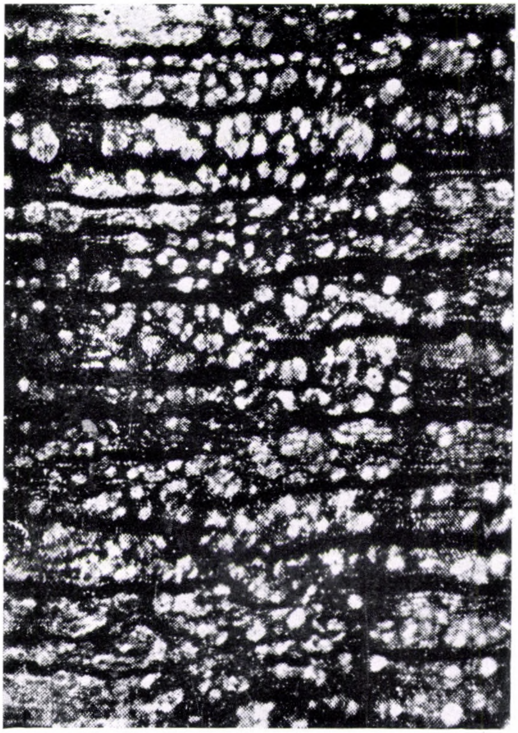
XXXVI. 1–9. *Ilicoxylon theresiae* n. sp. (Vékény, Helvetian)



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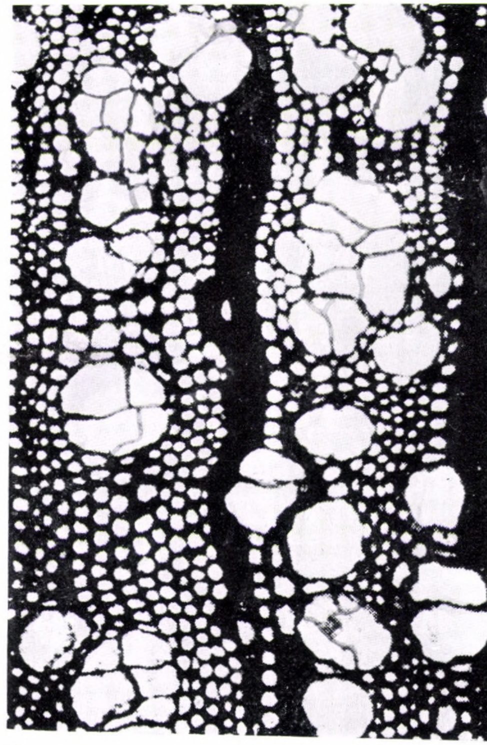

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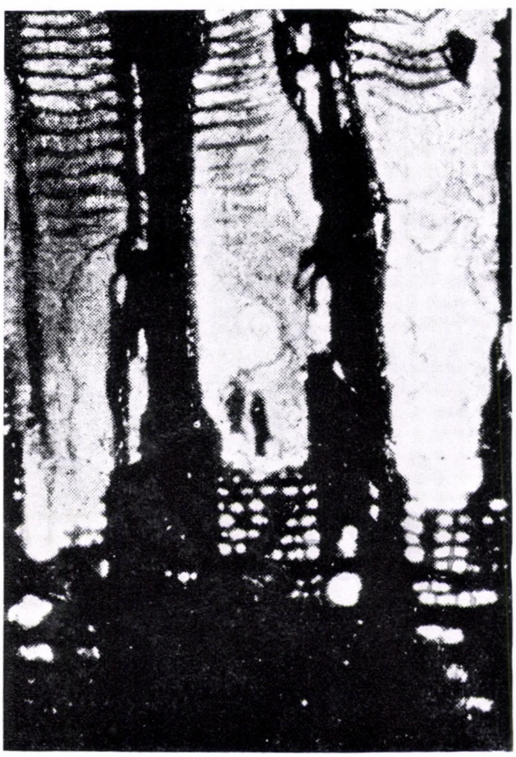

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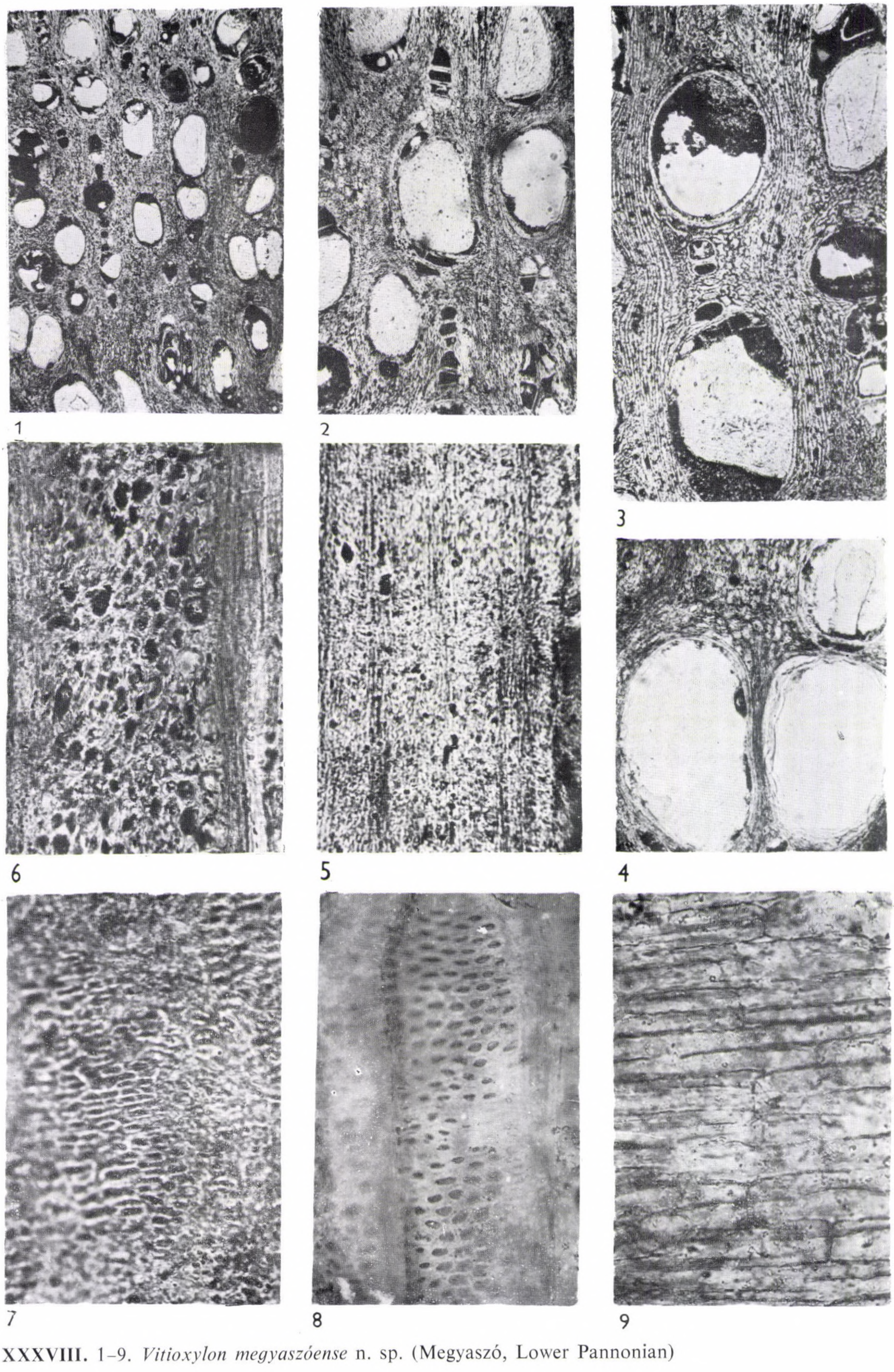
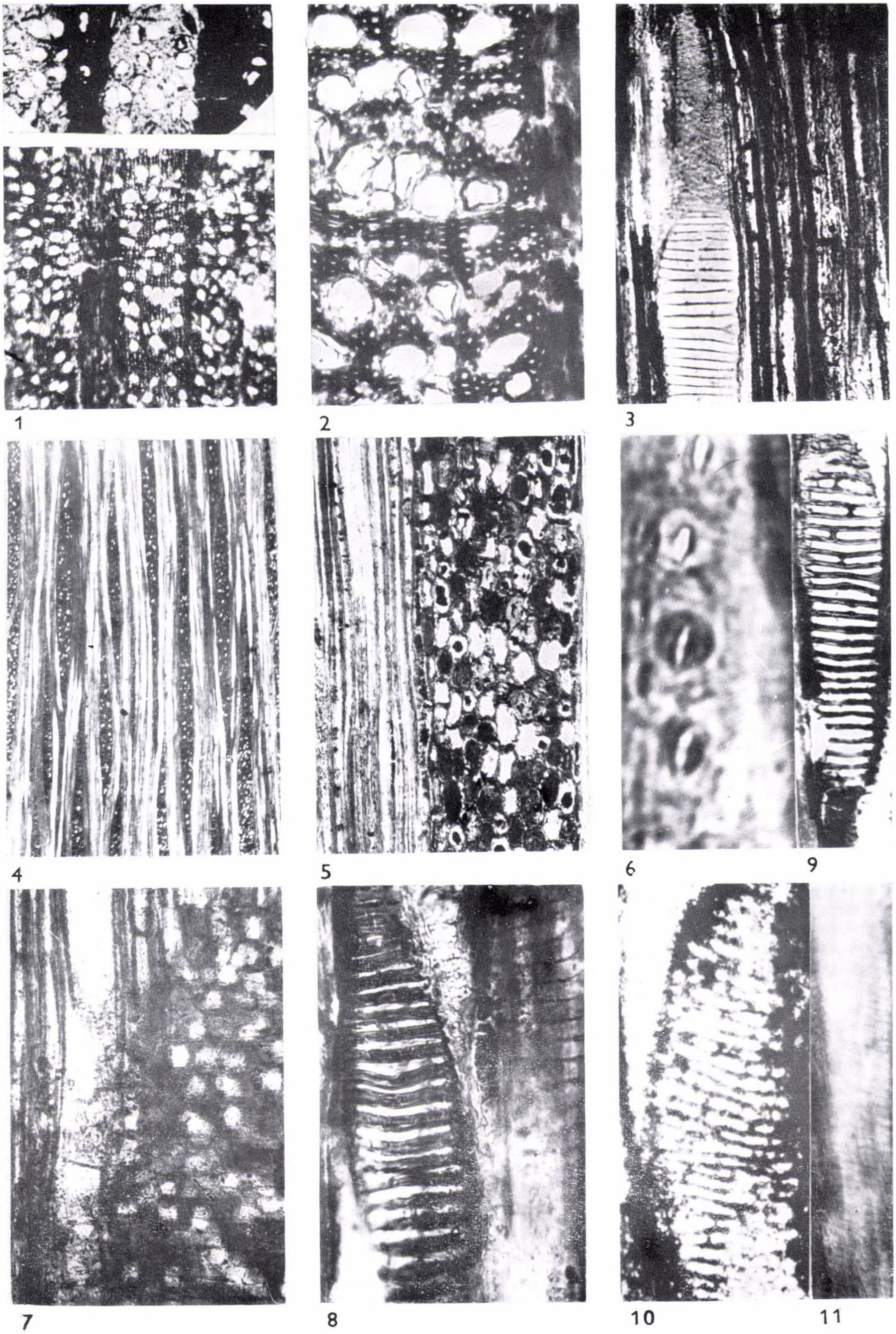
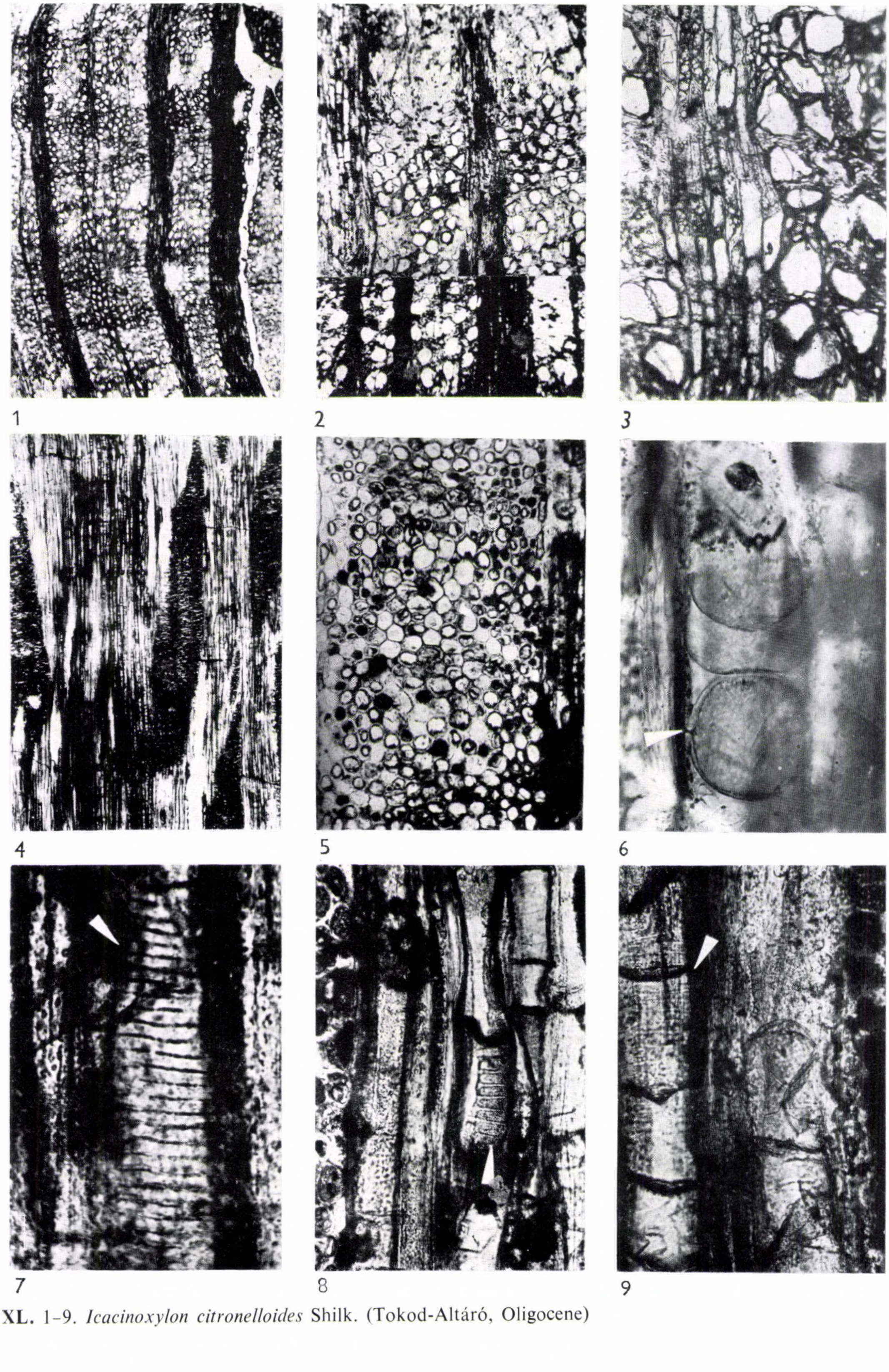
XXXVII. 1–4. *Ilicoxylon* cf. *aquifolium* Hofmann em. Greguss (Füzérkomlós, Sarmatian)



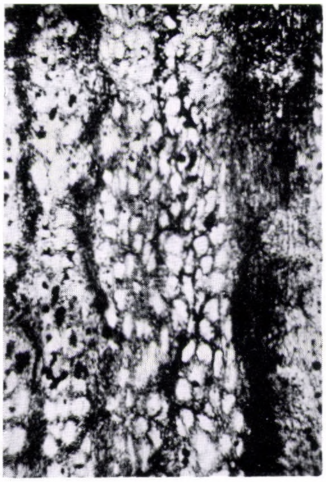
XXXVIII. 1–9. *Vitioxylon megyaszóense* n. sp. (Megyaszó, Lower Pannonian)



XXXIX. 1–11. *Citronella* cf. *mucronata* D. Don. (Ipolytarnóc, Burdigalian)



XL. 1–9. *Icacinoxylon citronelloides* Shilk. (Tokod-Altáró, Oligocene)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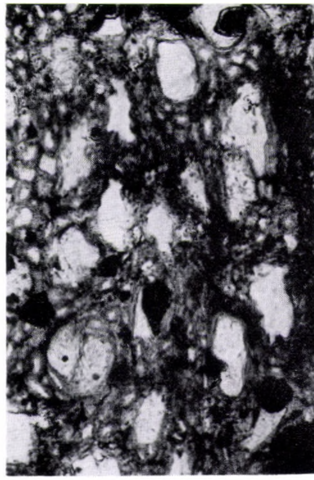
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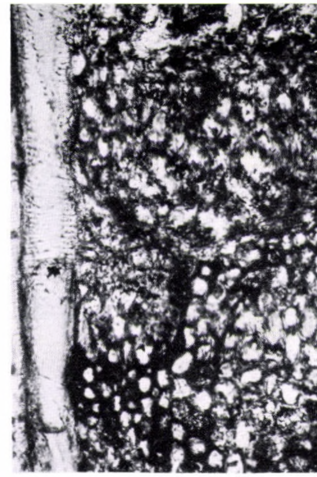
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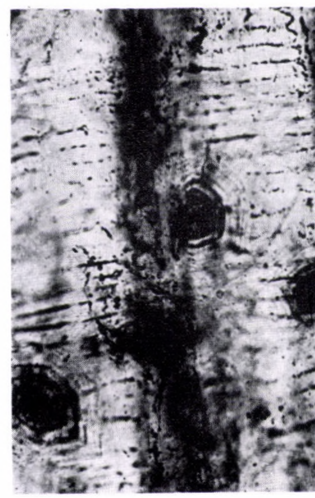
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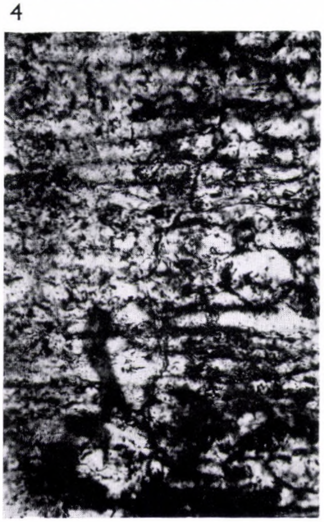
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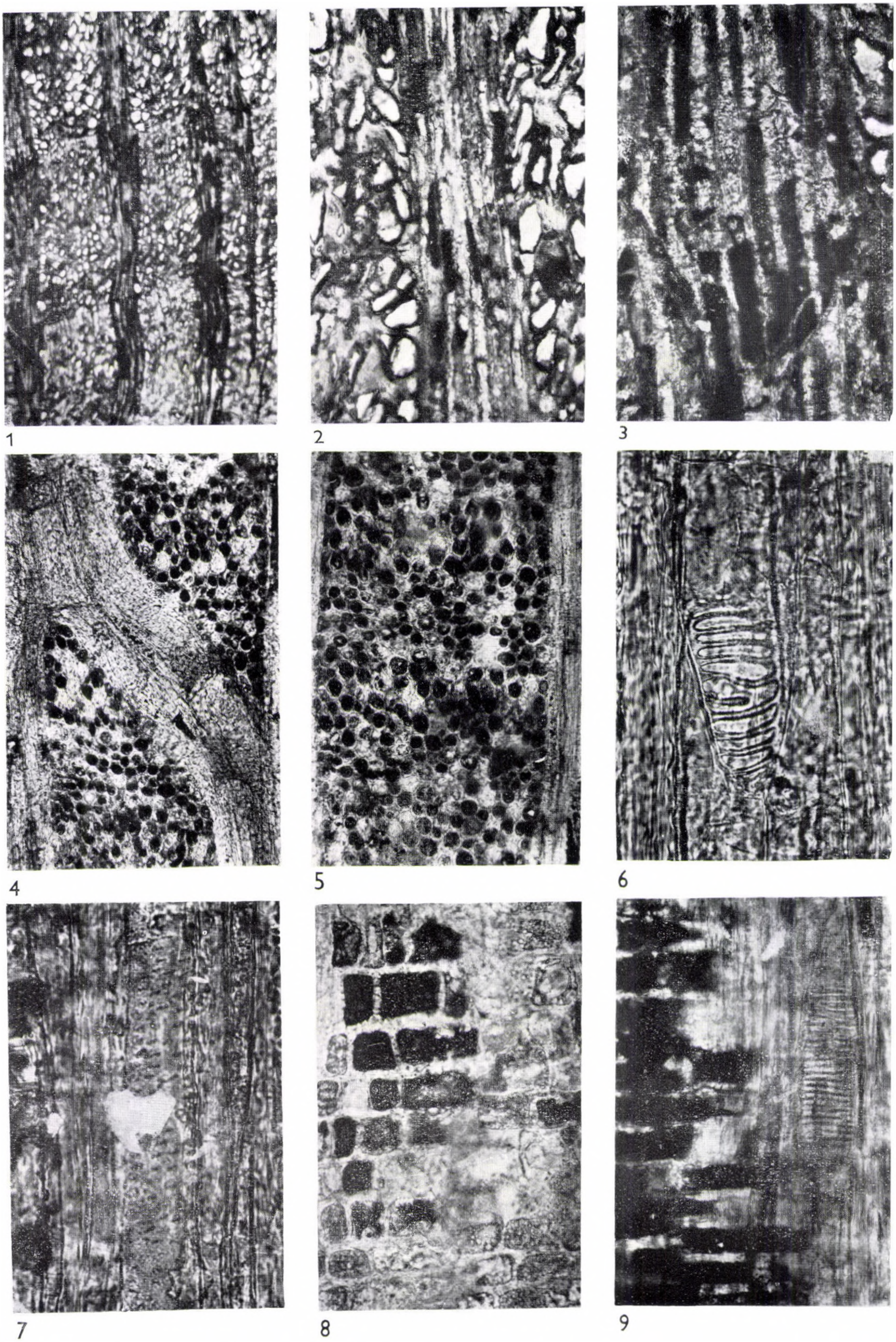
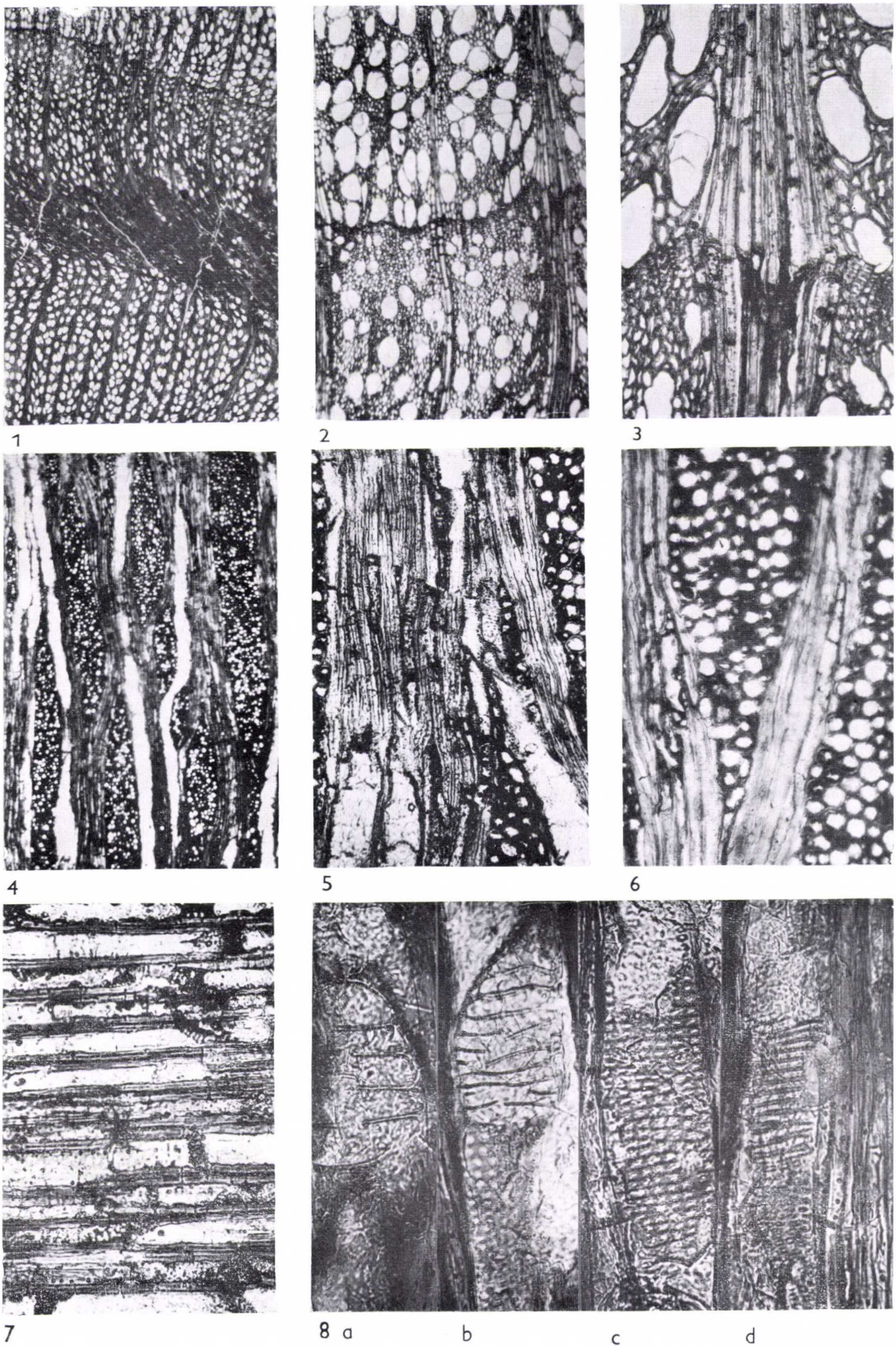
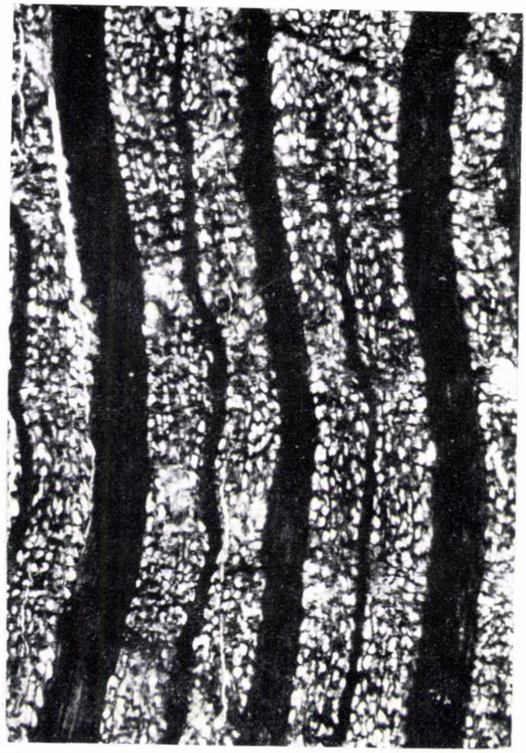
XLI. 1–9. *Icacinoxylon* cf. *citronelloides* Shilk. (Ajka, Helvetian)



XLII. 1–9. *Icacinoxylon* cf. *goderdzicum* Shilk. (Szilvásvárad, Sarmatian)



XLIII. 1–8. *Icacinoxylon hortobágyii* n. sp. (Balaton, Helvetian)



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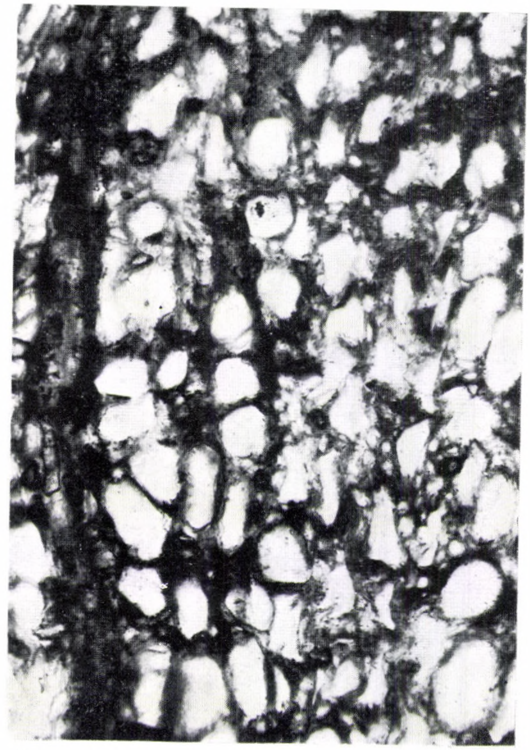

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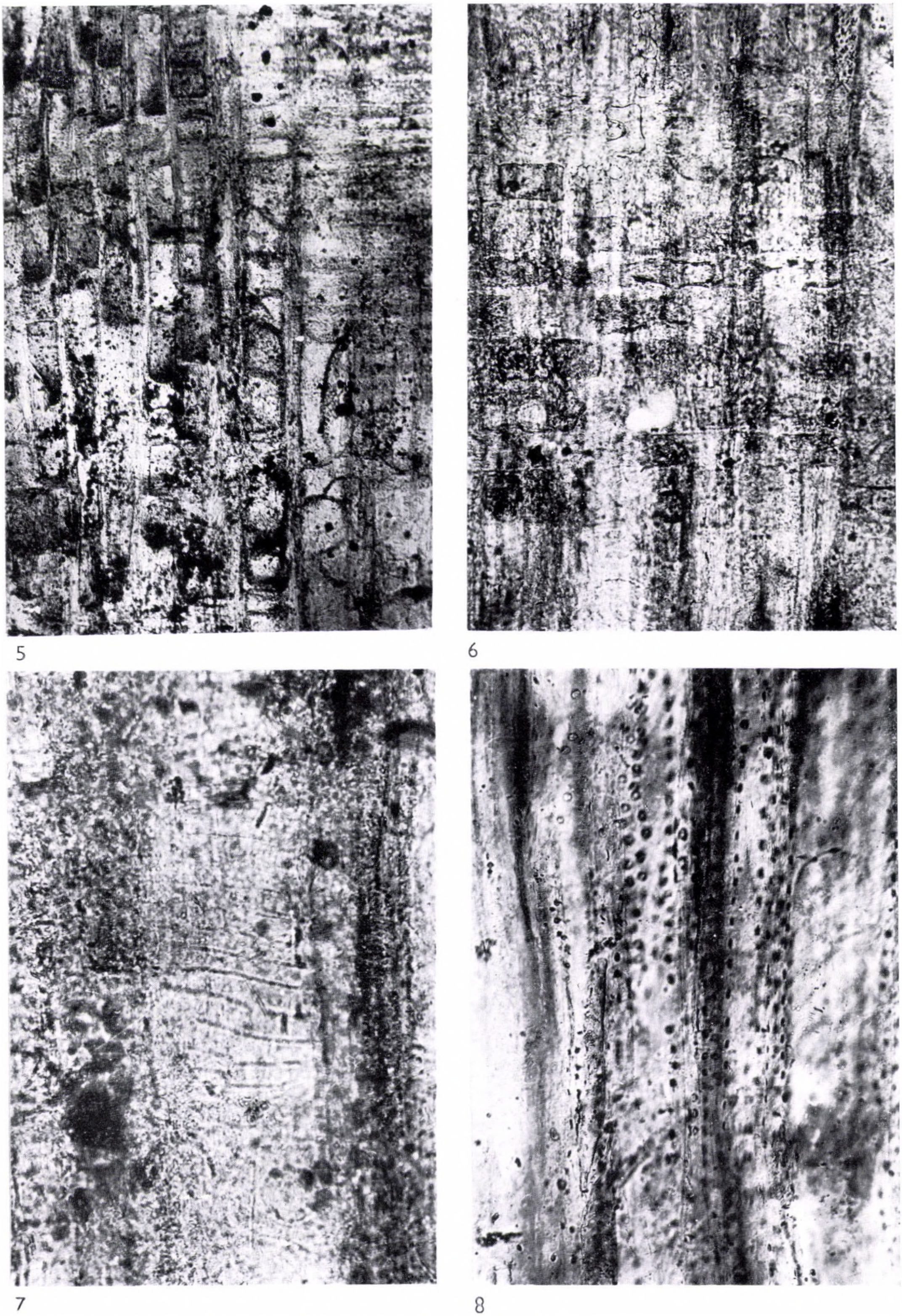
XLIV. 1–4. *Icacinoxylon laticiphorum* n. sp. (Dorog, Oligocene)



XLV. 5–8. *Icacinoxylon laticiphorum* n. sp. (Dorog, Oligocene)

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XLVI. 1–4. *Icacinoxylon crystallophorum* n. sp. (Dorog, Oligocene)

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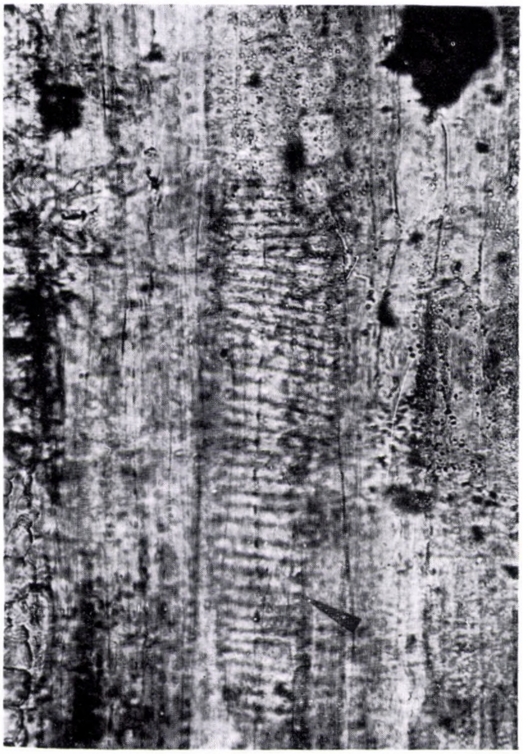

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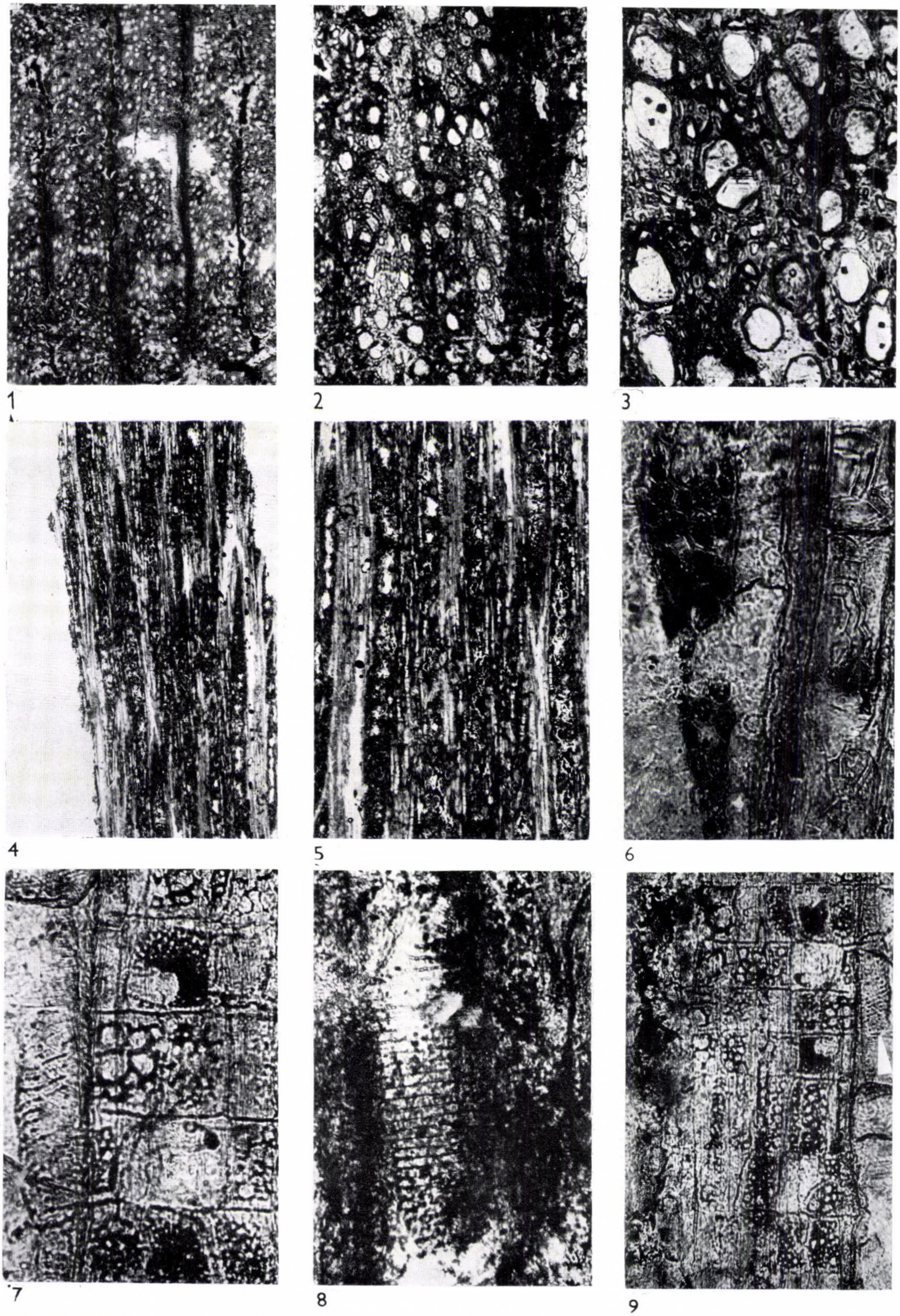
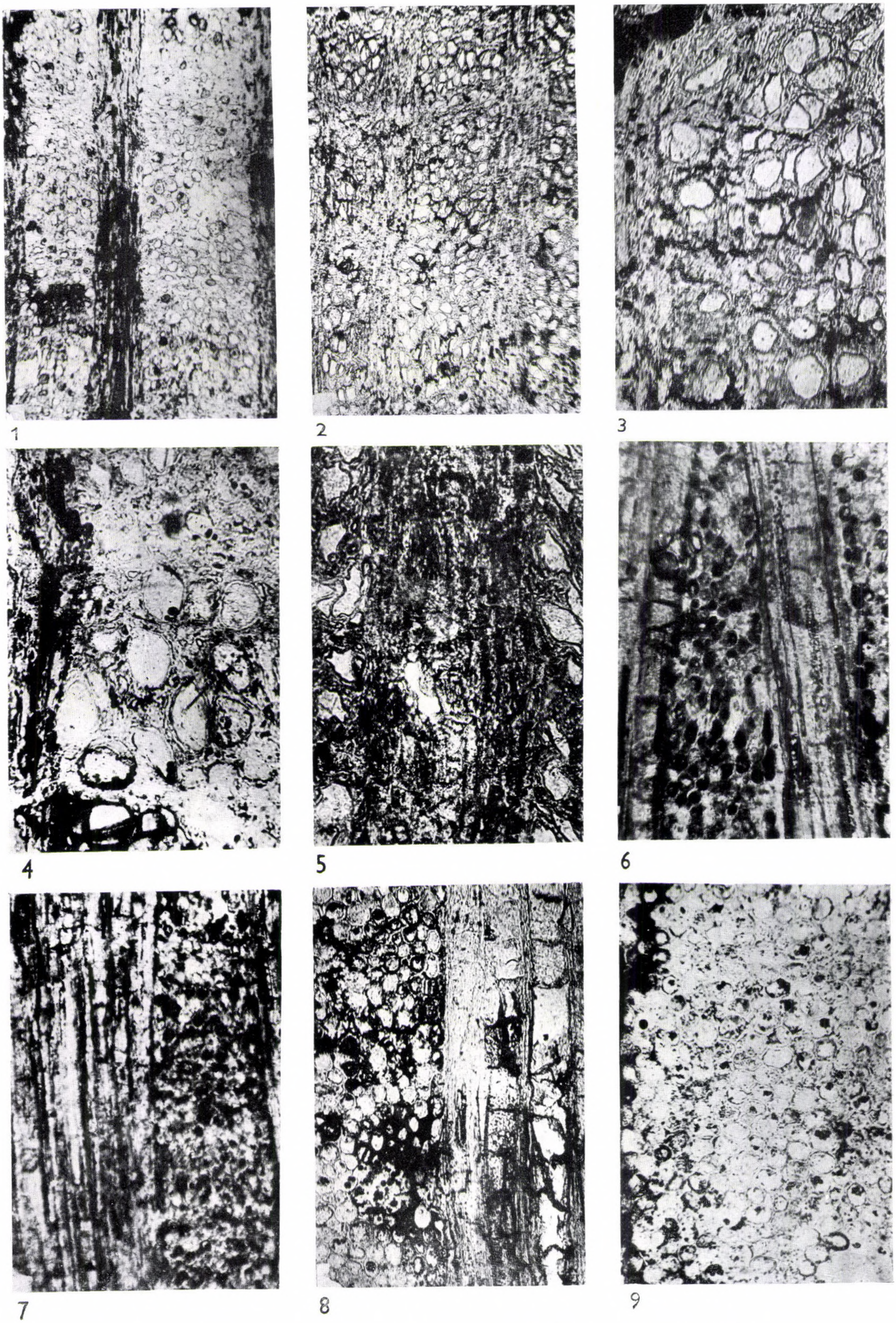
XLVII. 5–8. *Icacinoxylon crystallophorum* n. sp. (Dorog, Oligocene)

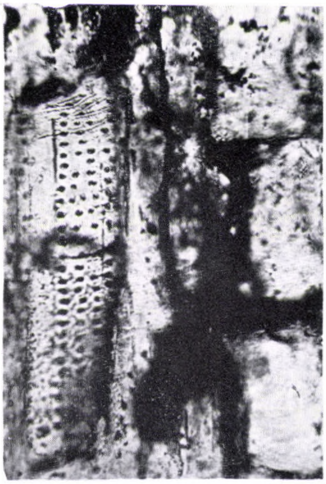


XLVIII. 1–9. *Icacinoxylon shilkinae* n. sp. (Pomáz, Helvetian)

XLIX. 1–9. *Icacinoxylon platanoides* n. sp. (Zirc, Helvetian)



L. 1–9. *Icacinoxylon sylvaticum* (Tuzson) Greguss n. comb. (Ipolytarnóc, Burdigalian)



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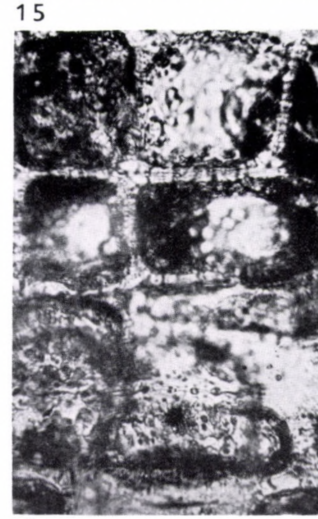

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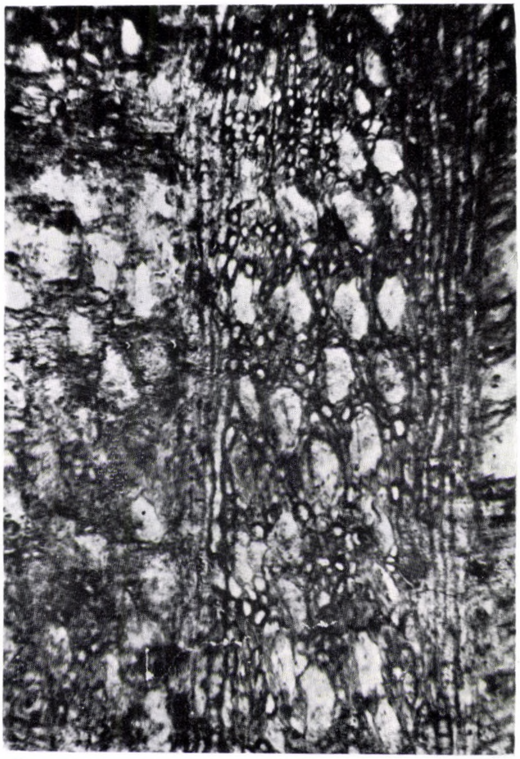
LI. 10–18. *Icacinoxylon sylvaticum* (Tuzson) Greguss n. comb. (Ipolytarnóc, Burdigalian)



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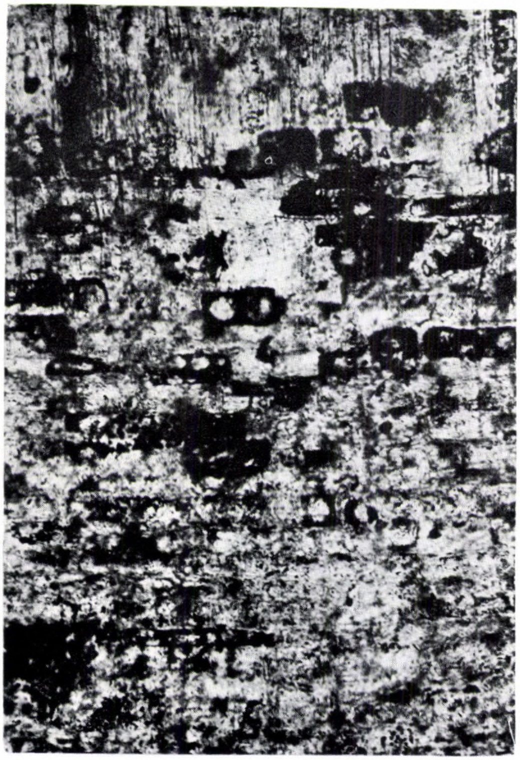

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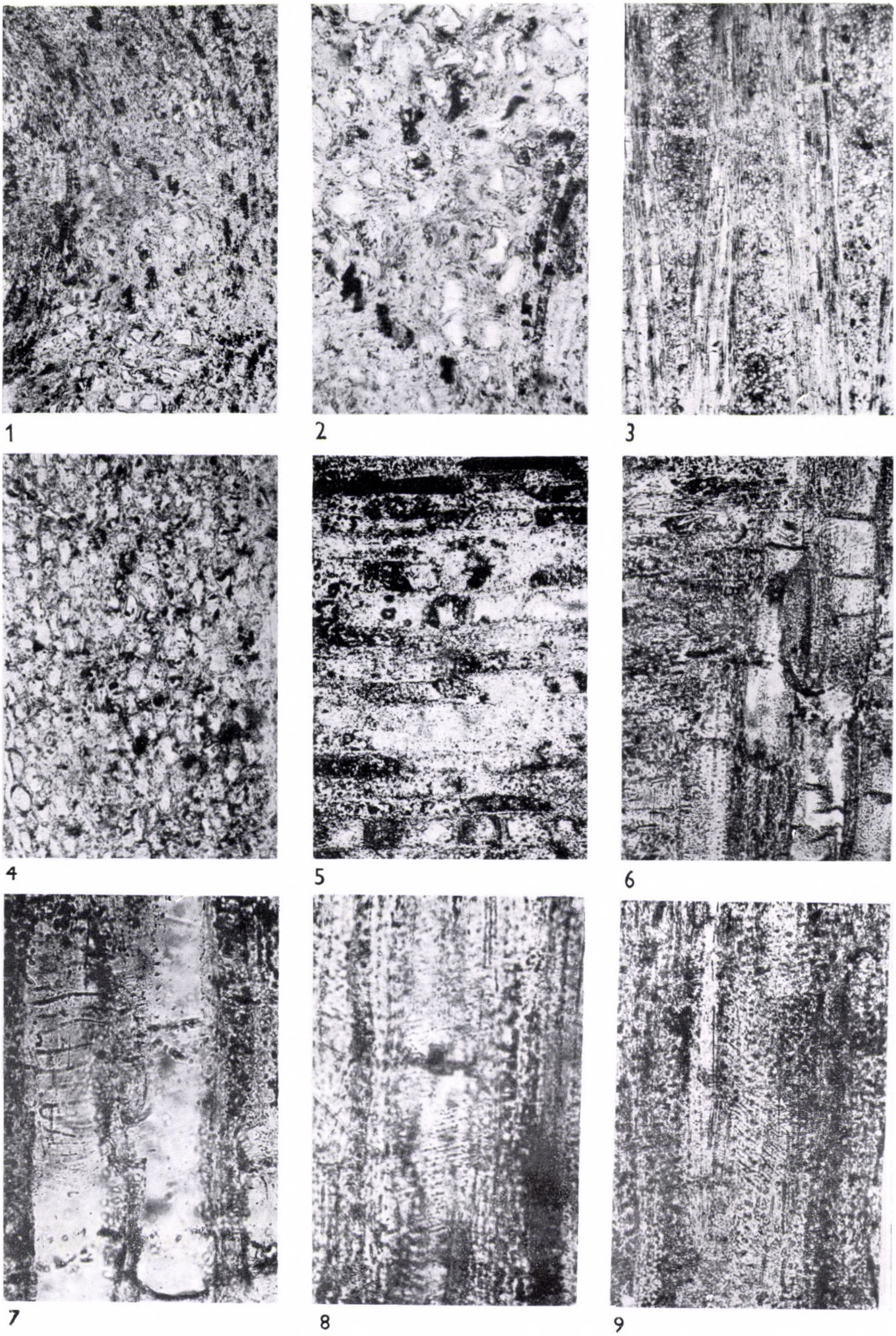
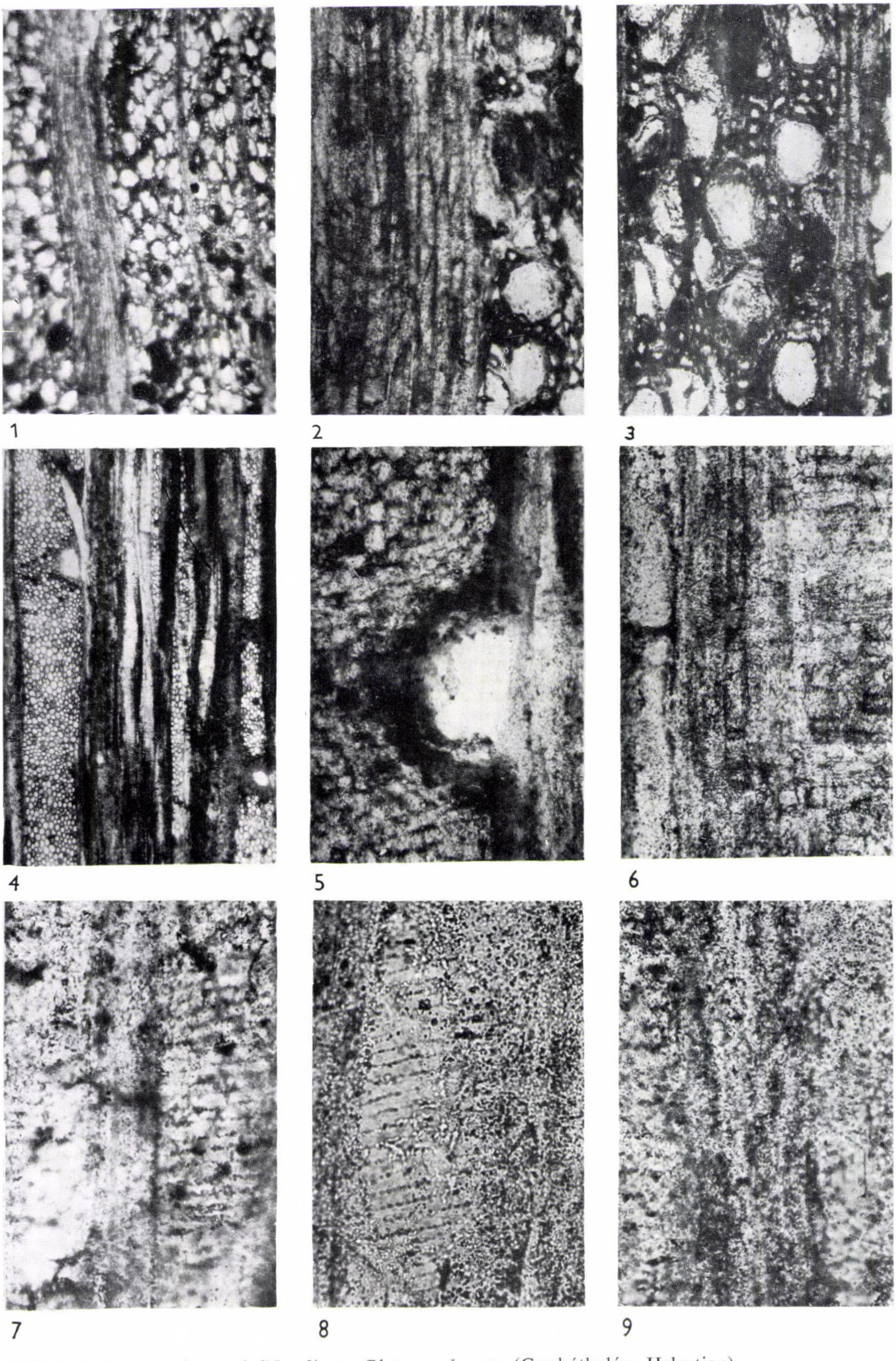
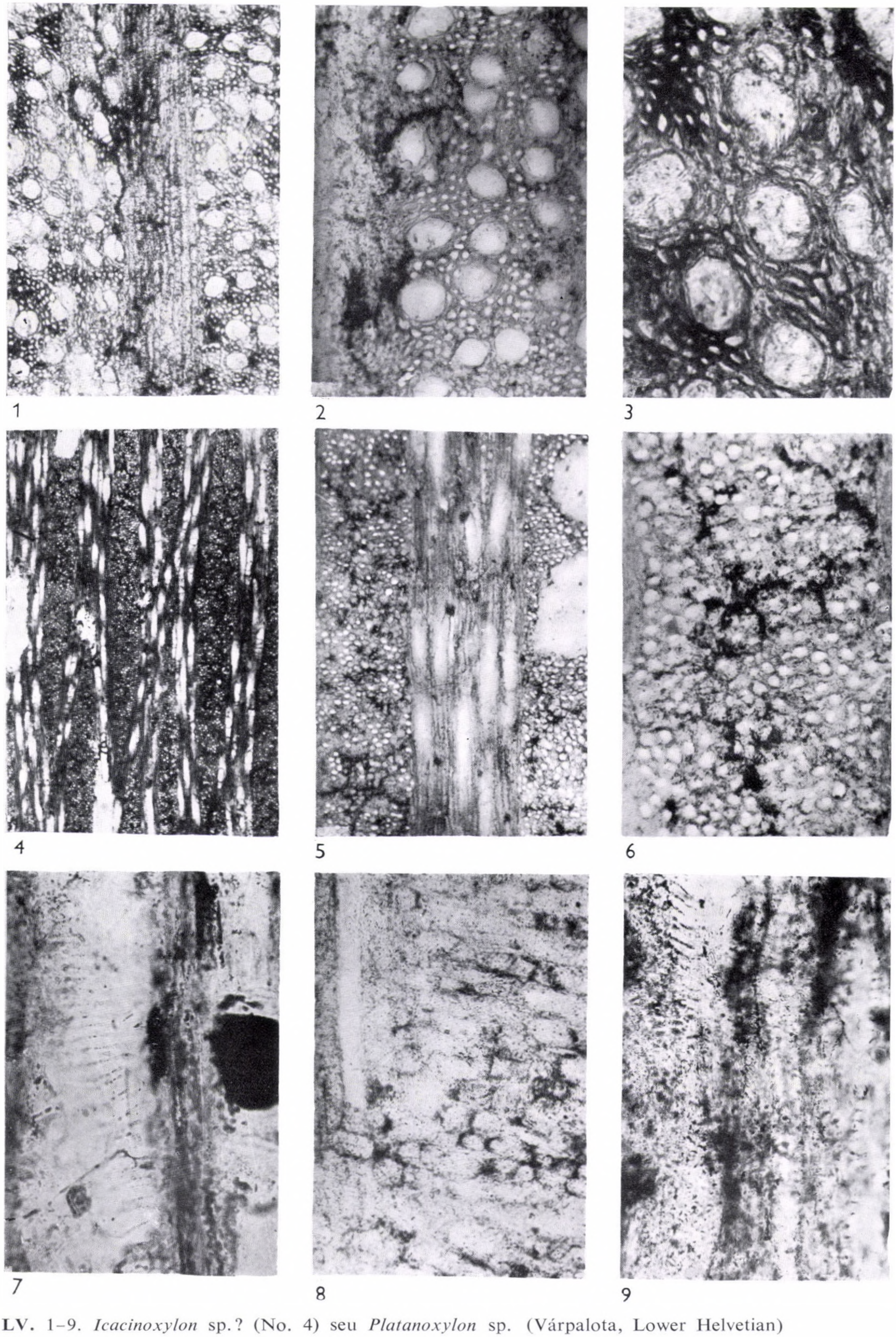
LII. 1-4. *Icacinoxylon* sp.? (No. 1) seu *Platanoxylon* sp. (Dorog, Oligocene)



LIII. 1–9. *Icacinoxylon* sp.? (No. 2) seu *Platanoxylon* sp. (Bajna, Oligocene)



LIV. 1–9. *Icacinoxylon* sp.? (No. 3) seu *Platanoxylon* sp. (Cserháthaláp, Helvetian)



LV. 1–9. *Icacinoxylon* sp.? (No. 4) seu *Platanoxylon* sp. (Várpalota, Lower Helvetian)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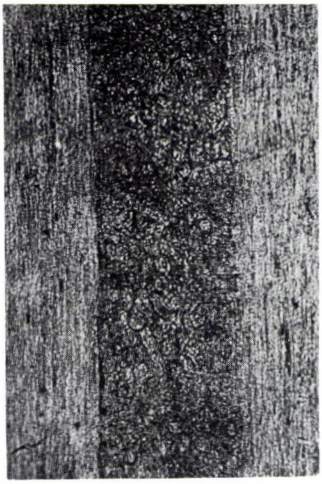
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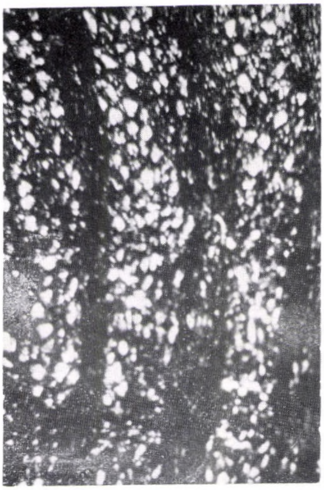
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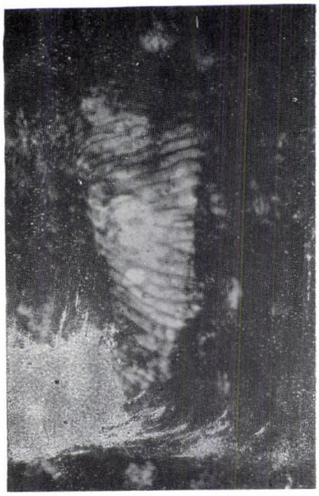
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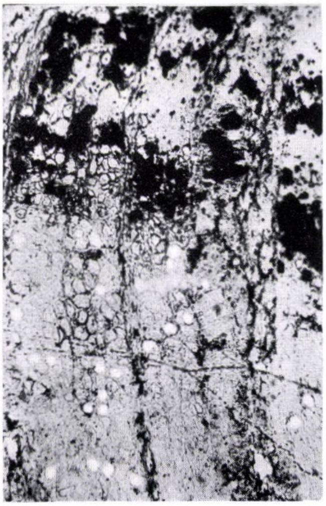
LVI. 1–6. *Icacinoxylon* sp.? (No. 5) seu *Platanoxylon* sp. (Cinkota, Helvetian)
7–9. *Icacinoxylon* sp.? (No. 17) seu *Platanoxylon* sp. (Nagybátony, Burdigalian)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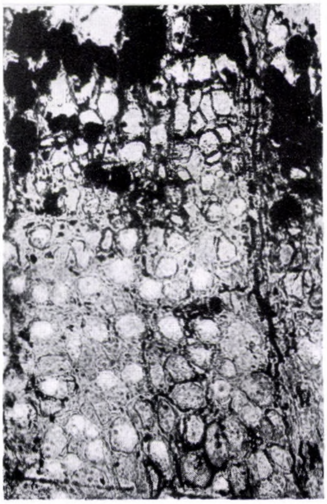
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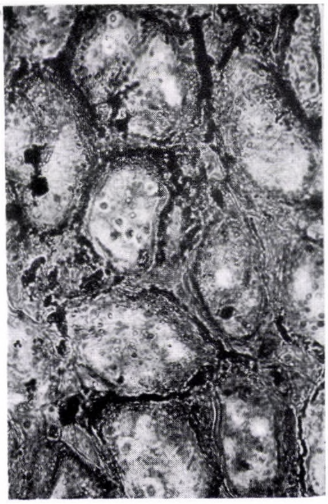
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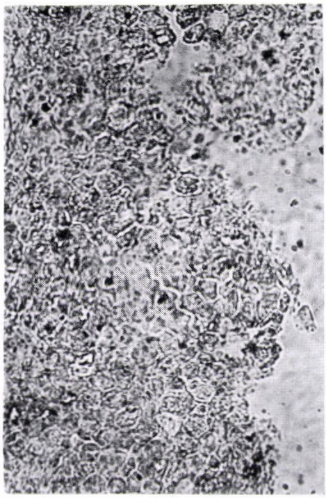
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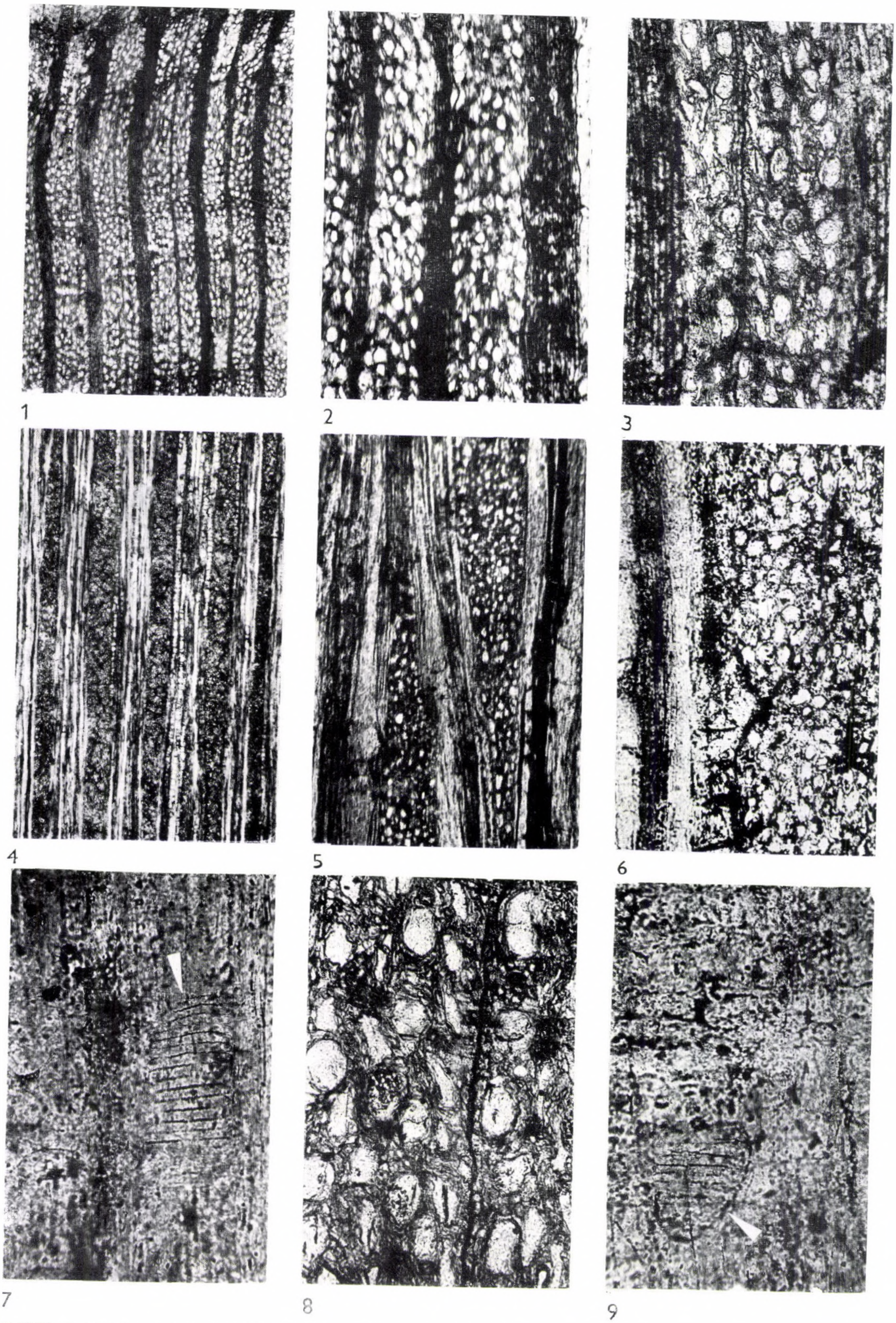
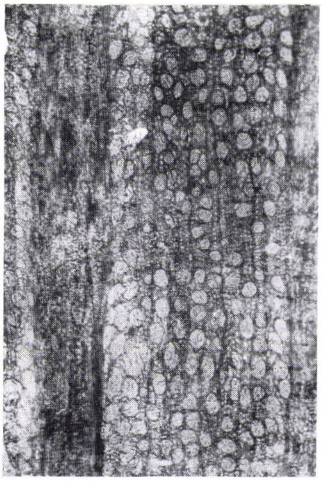
LVII. 1–9. *Icacinoxylon* sp.? (No. 6) seu *Platanoxylon* sp. (Pécsszabolcs, Helvetian)



LVIII. 1–7. *Icacinoxylon* sp.? (No. 7) seu *Platanoxylon* sp. (Mór, Helvetian)
8 and 9. *Icacinoxylon* sp.? (No. 8) seu *Platanoxylon* sp. (Megyaszó, Sarmatian)



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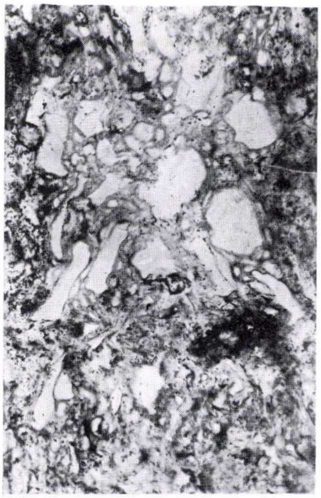

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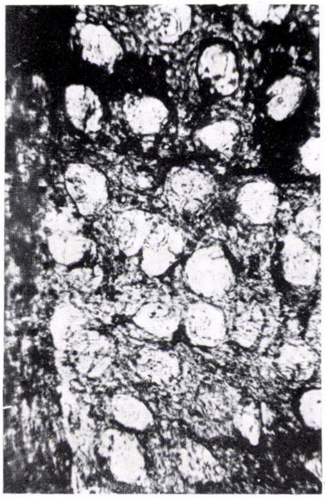

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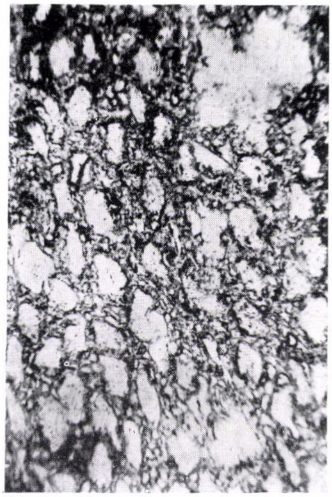

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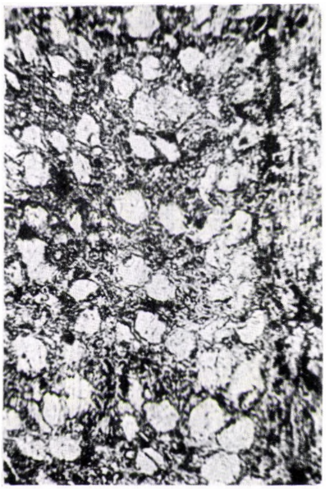
LIX. 1–3. *Icacinoxylon* sp.? (No. 15) seu *Platanoxylon* sp. (Pénzeskút, Helvetian)
4 and 5. *Icacinoxylon* sp.? (No. 9) seu *Platanoxylon* sp. (Budapest, Helvetian)
6. *Icacinoxylon* sp.? (No. 10) seu *Platanoxylon* sp. (Hárságy, Helvetian)
7 and 8. *Icacinoxylon* sp.? (No. 14) seu *Platanoxylon* sp. (Solymár, Oligocene)
9. *Icacinoxylon* sp.? (No. 16) seu *Platanoxylon* sp. (Rátka, Sarmatian)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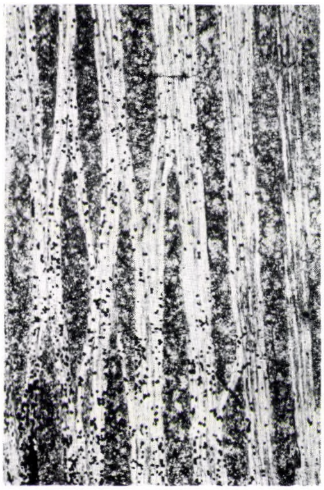
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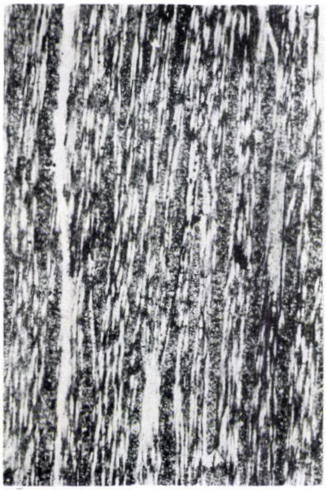
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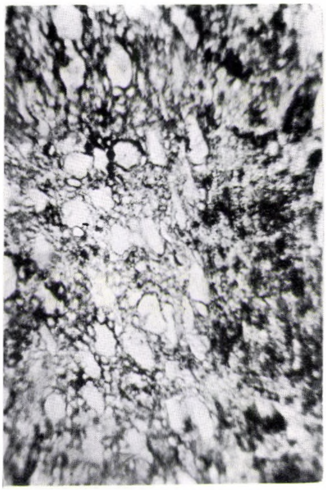
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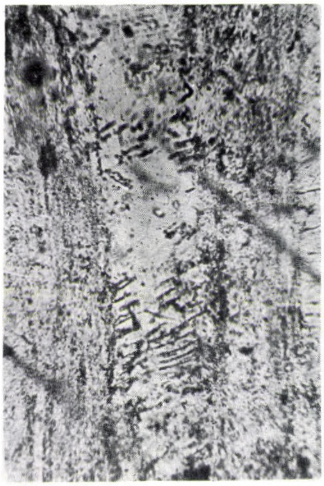
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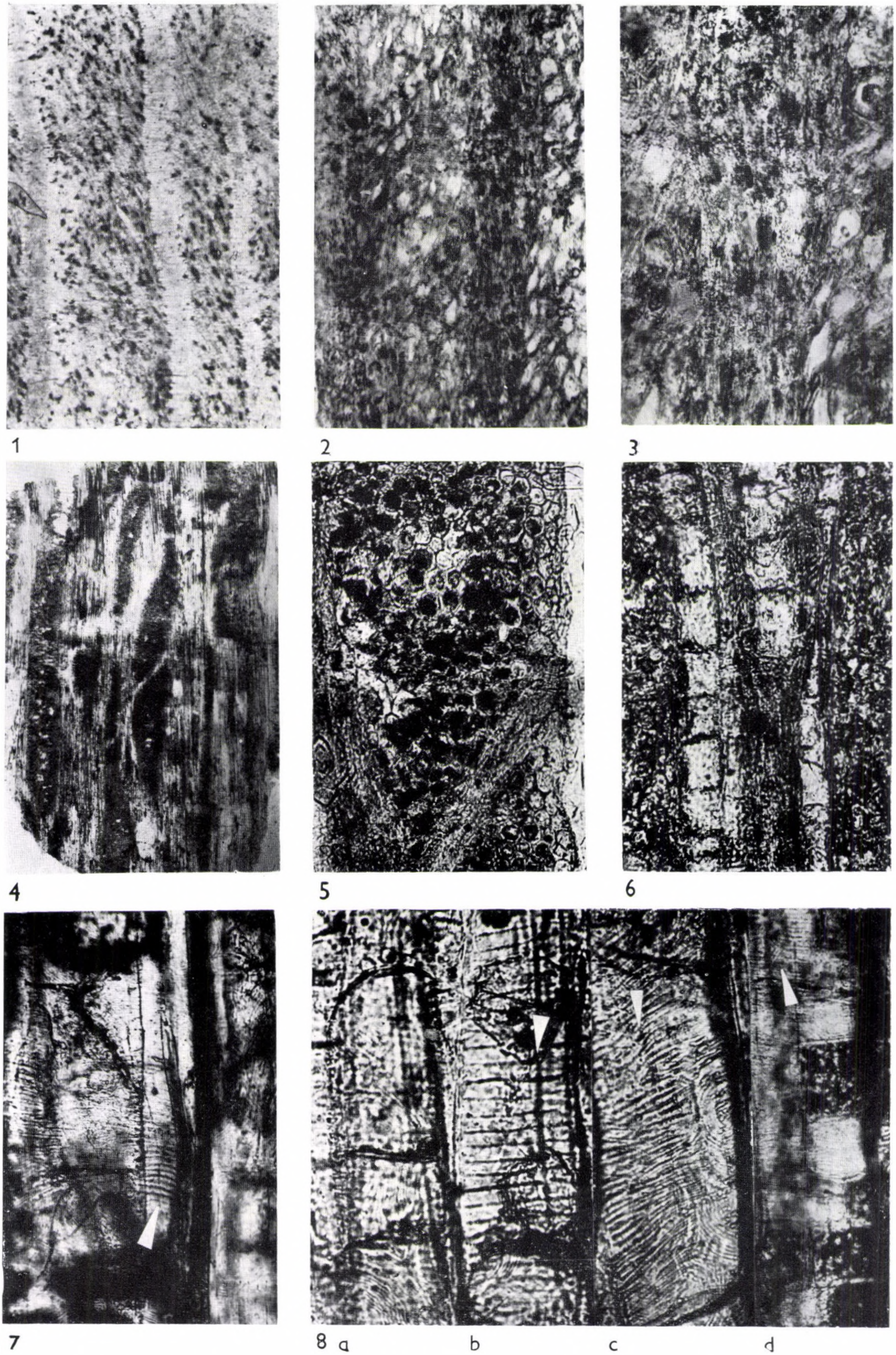
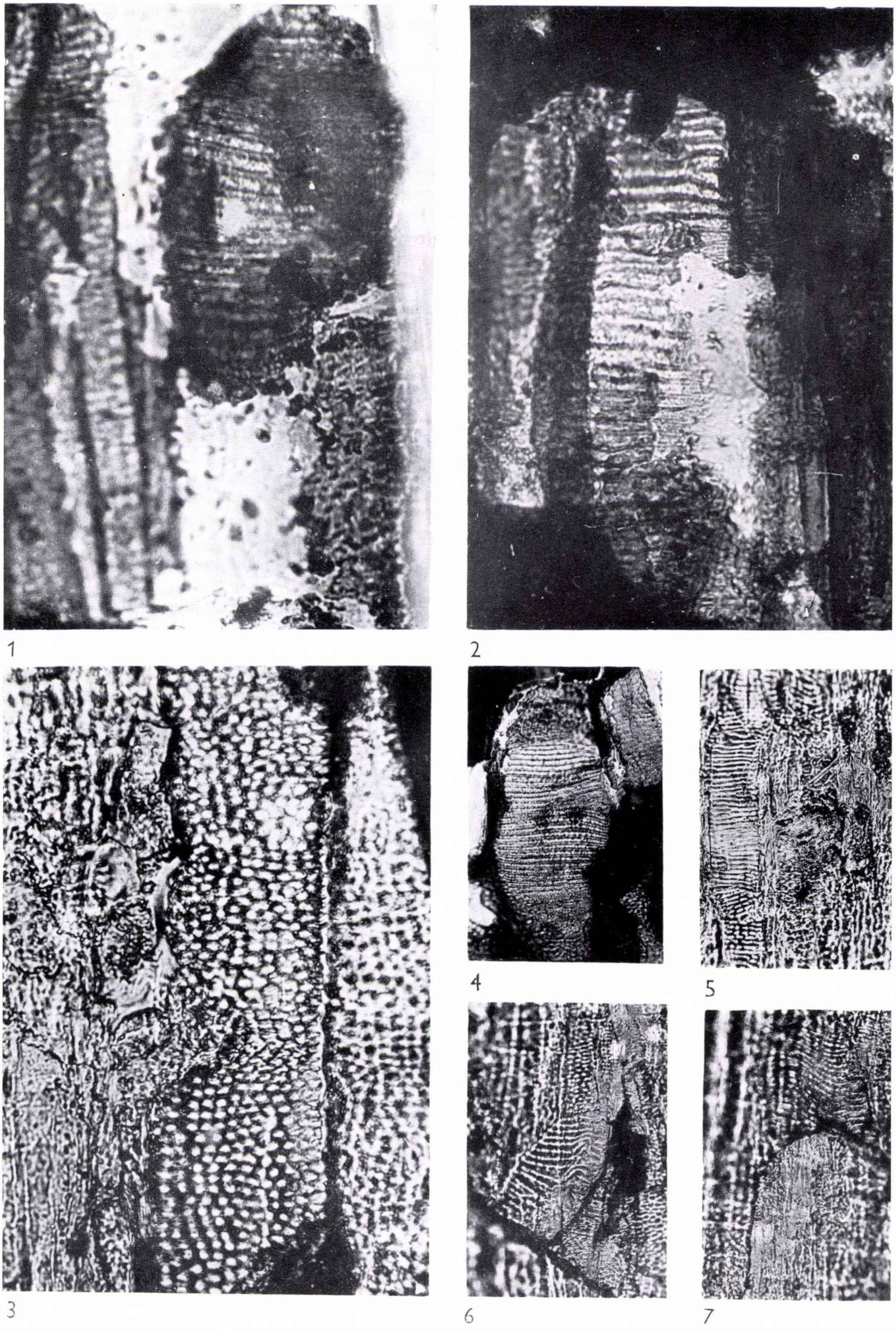
LX. 1 and 2. *Icacinoxylon* sp.? (No. 11) seu *Platanoxylon* sp. (Bodajk, Lower Helvetian)
3–6. *Icacinoxylon* sp.? (No. 12) seu *Platanoxylon* sp. (Iszkaszentgyörgy, Helvetian)
7–9. *Icacinoxylon* sp.? (No. 13) seu *Platanoxylon* sp. (Homokbödöge, Helvetian)

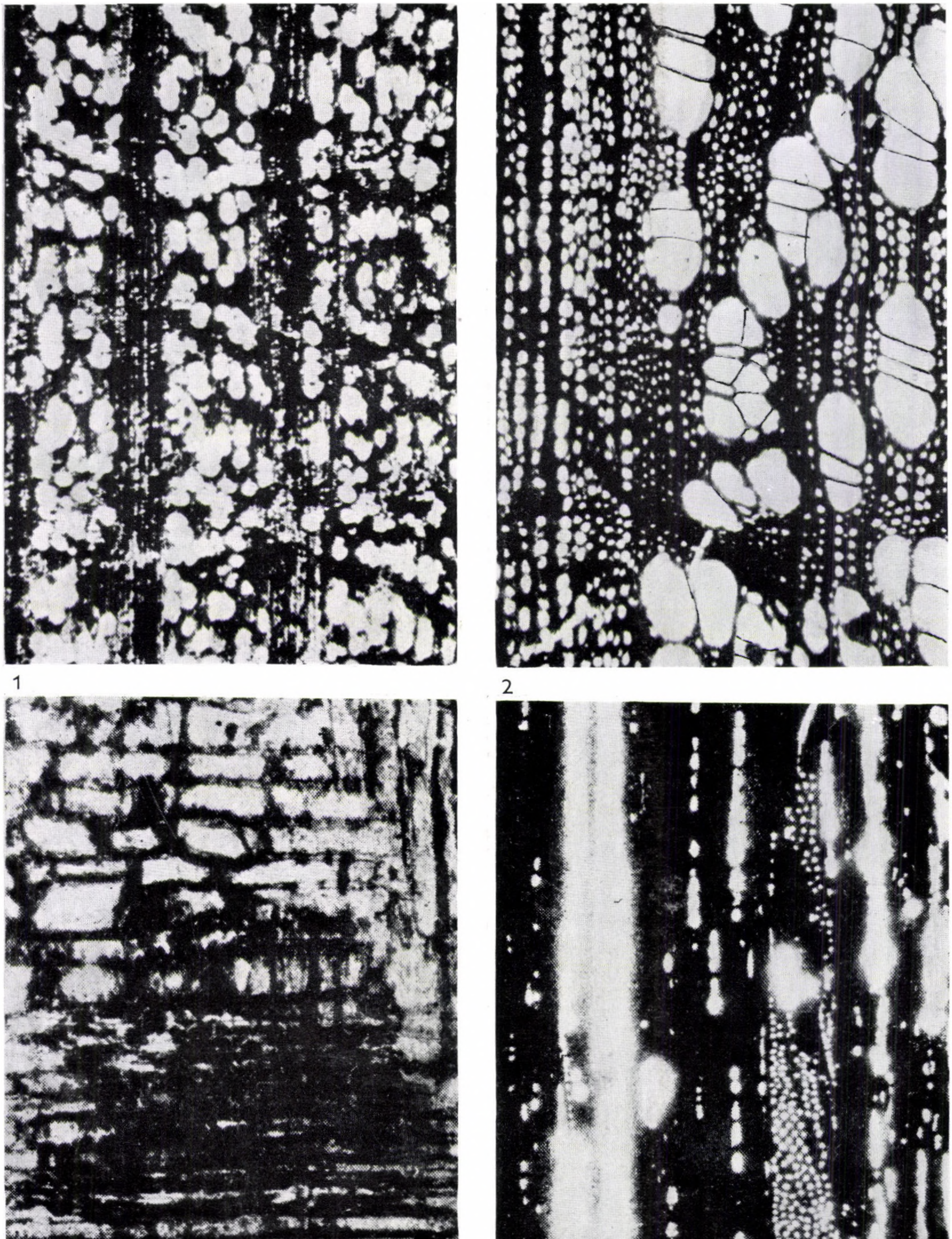
LXI. 1–9. *Icacinoxylon* sp.? (No. 17) seu *Platanoxylon* sp. (Nagybátony, Burdigalian)



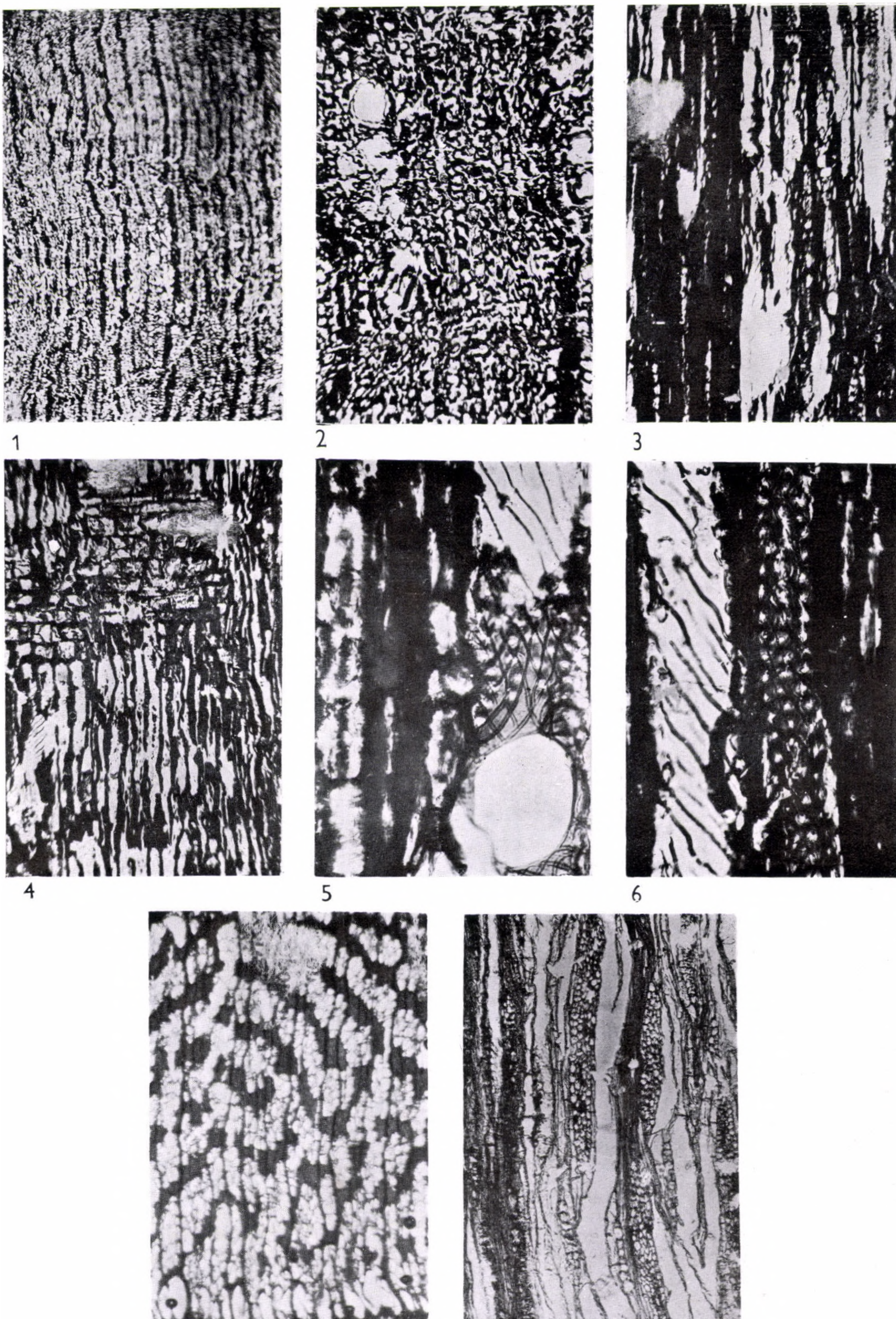
LXII. 1–8. *Icacinoxylon* sp.? (No. 18) seu *Platanoxylon* sp. (Nógrád, Helvetian)



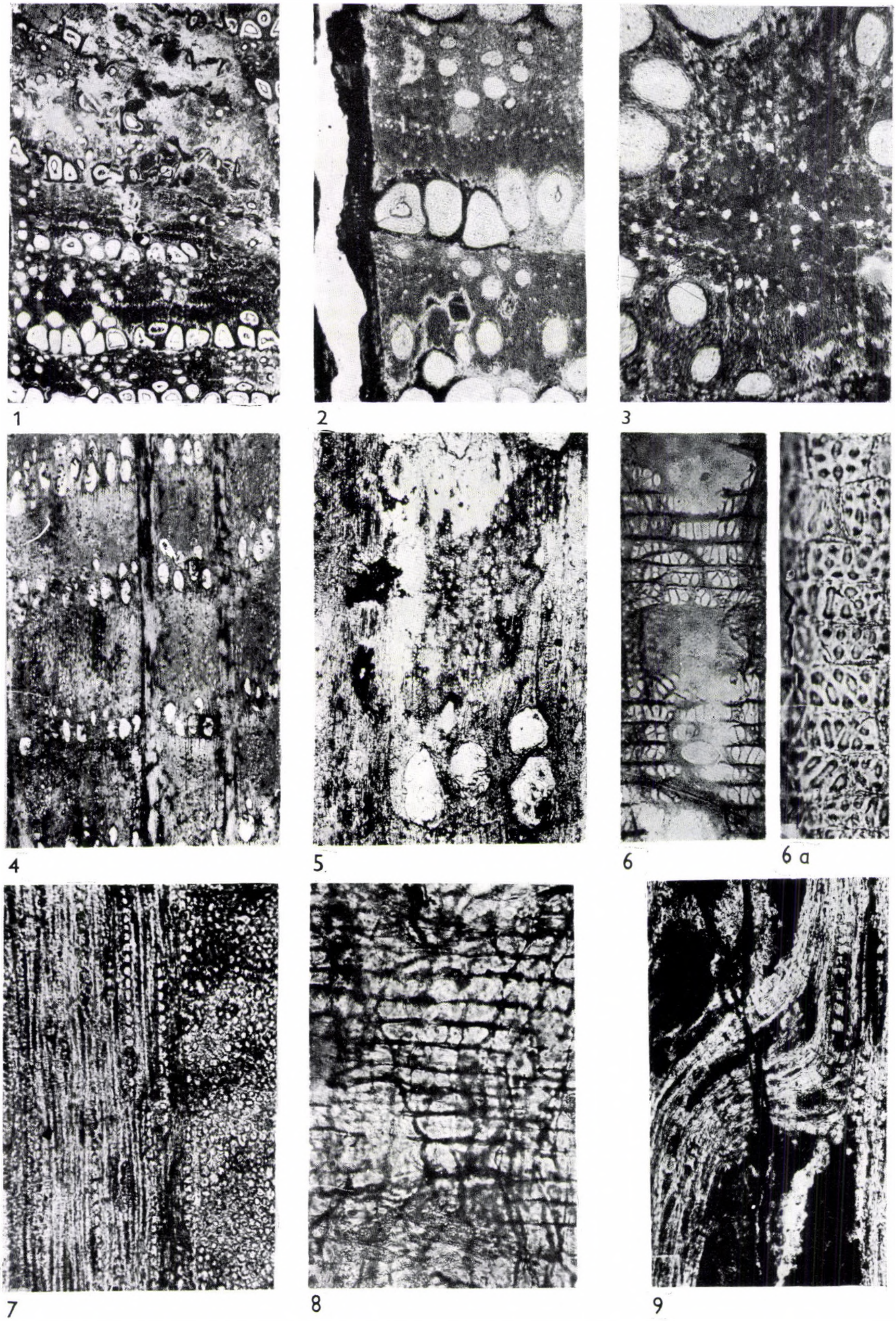
LXIII. 1–7. *Alnus* sp. (Emőd, Pleistocene)



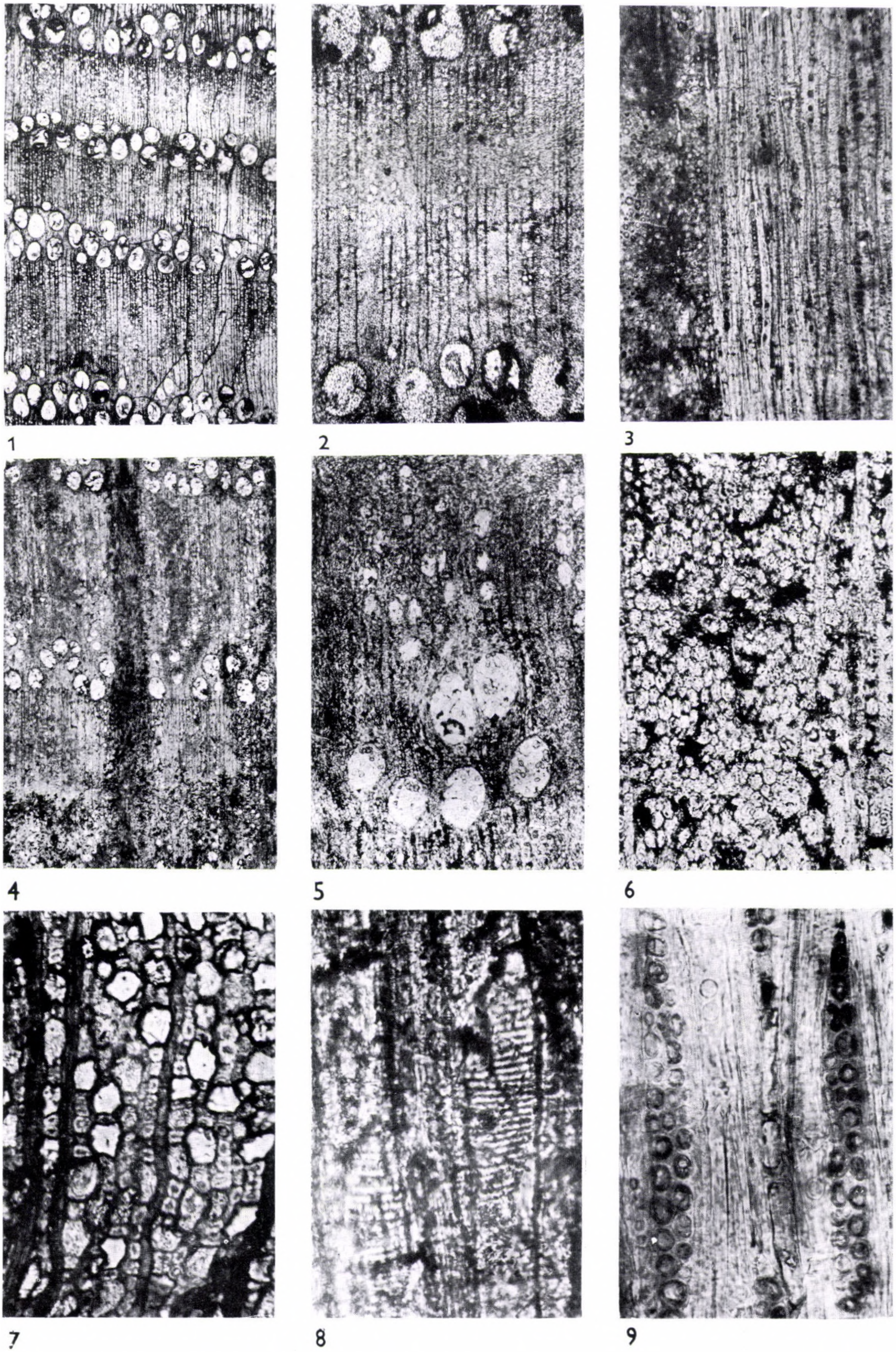
LXIV. 1–4. *Carpinoxylon hungaricum* Greguss (Füzérkomlós, Sarmatian)



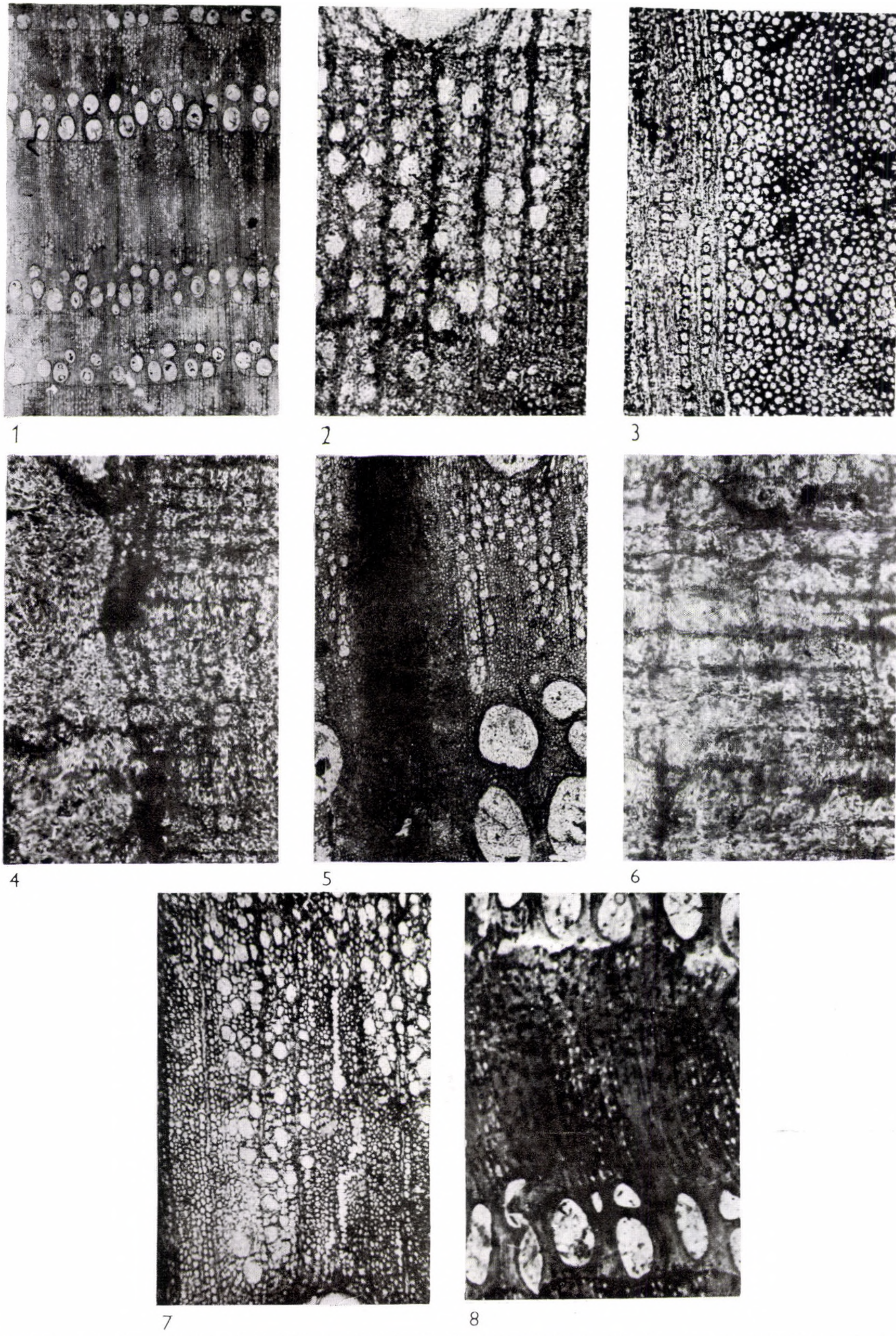
LXV. 1–6. *Carpinoxylon* sp. (Ipolytarnóc, Burdigalian)
7 and 8. *Ulmus* sp. (Újfalu, Pleistocene)



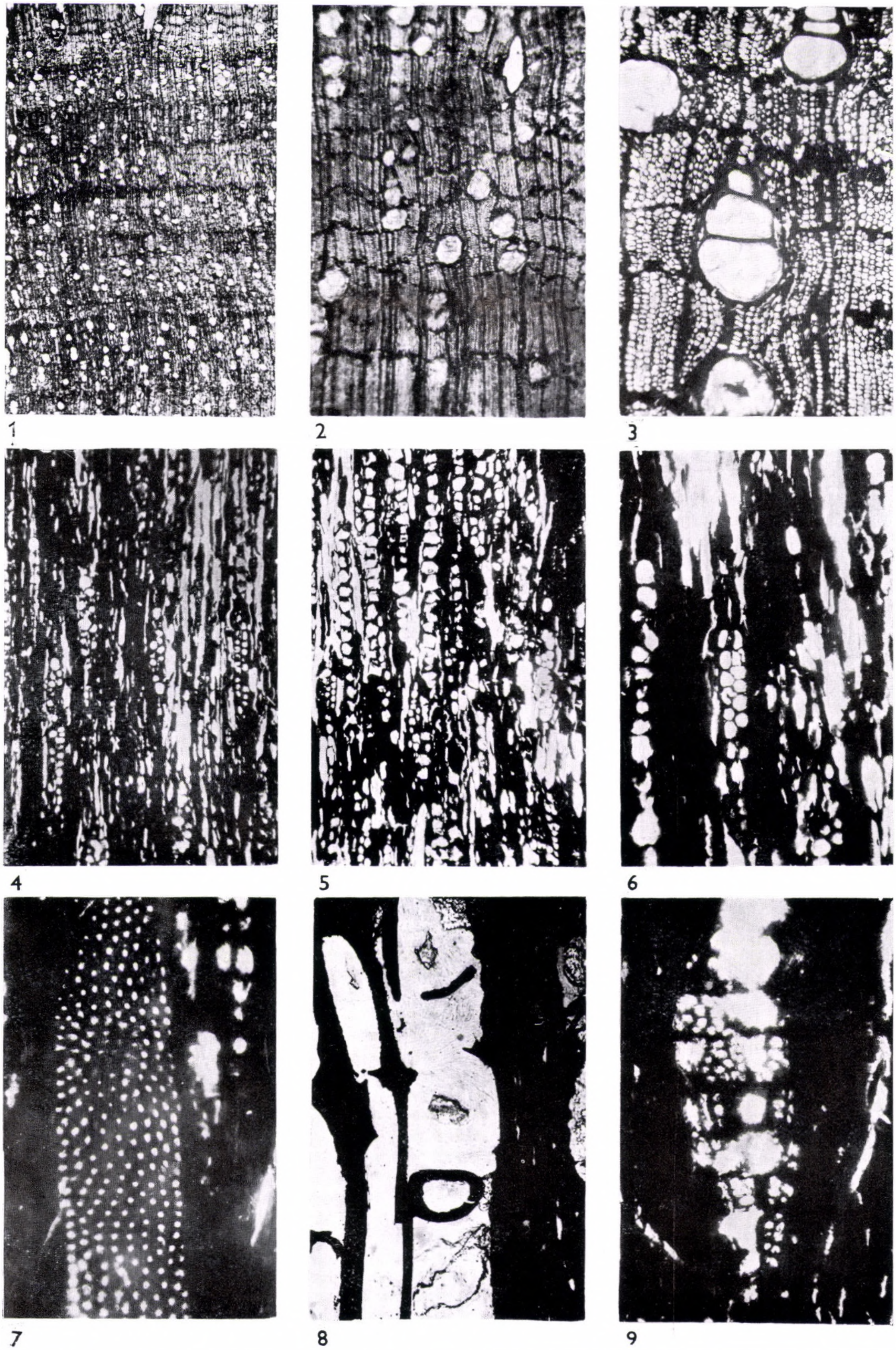
LXVI. 1–3, 6, 6a and 9. *Quercoxylon suberoides* n. sp. (Sály, Sarmatian)
4, 5, 7 and 8. *Quercoxylon* sp. (No. 3) (Pestszentlőrinc, Pannonian)



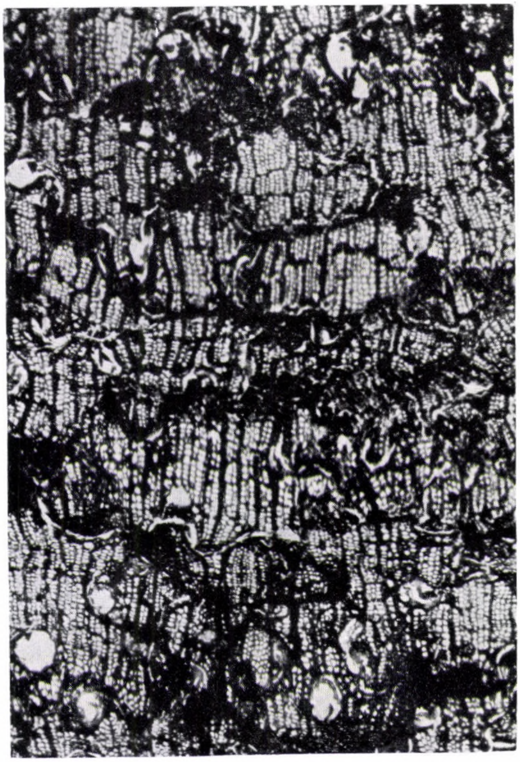
LXVII. 1–3. *Quercoxylon* sp. (No. 1) (Monosbél, Helvetian)
4–6. *Quercus* sp. (No. 2) (Cegléd, Pleistocene)
7–9. *Liquidambaroxylon* cf. *styraciflua* (Sámsonháza, Helvetian)



LXVIII. 1–4. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 1) (Kemenesmagasi, Pannonian)
5–7. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 2) (Tata, Oligocene)
8. *Quercoxylon* cf. *böckhianum* Müller-Stoll and Mädel (No. 3) (Dorog, Oligocene)



LXIX. 1–9. *Pterocaryoxylon pannonicum* Müller-Stoll and Mädel (Parádfürdő, Lower Helvetian)



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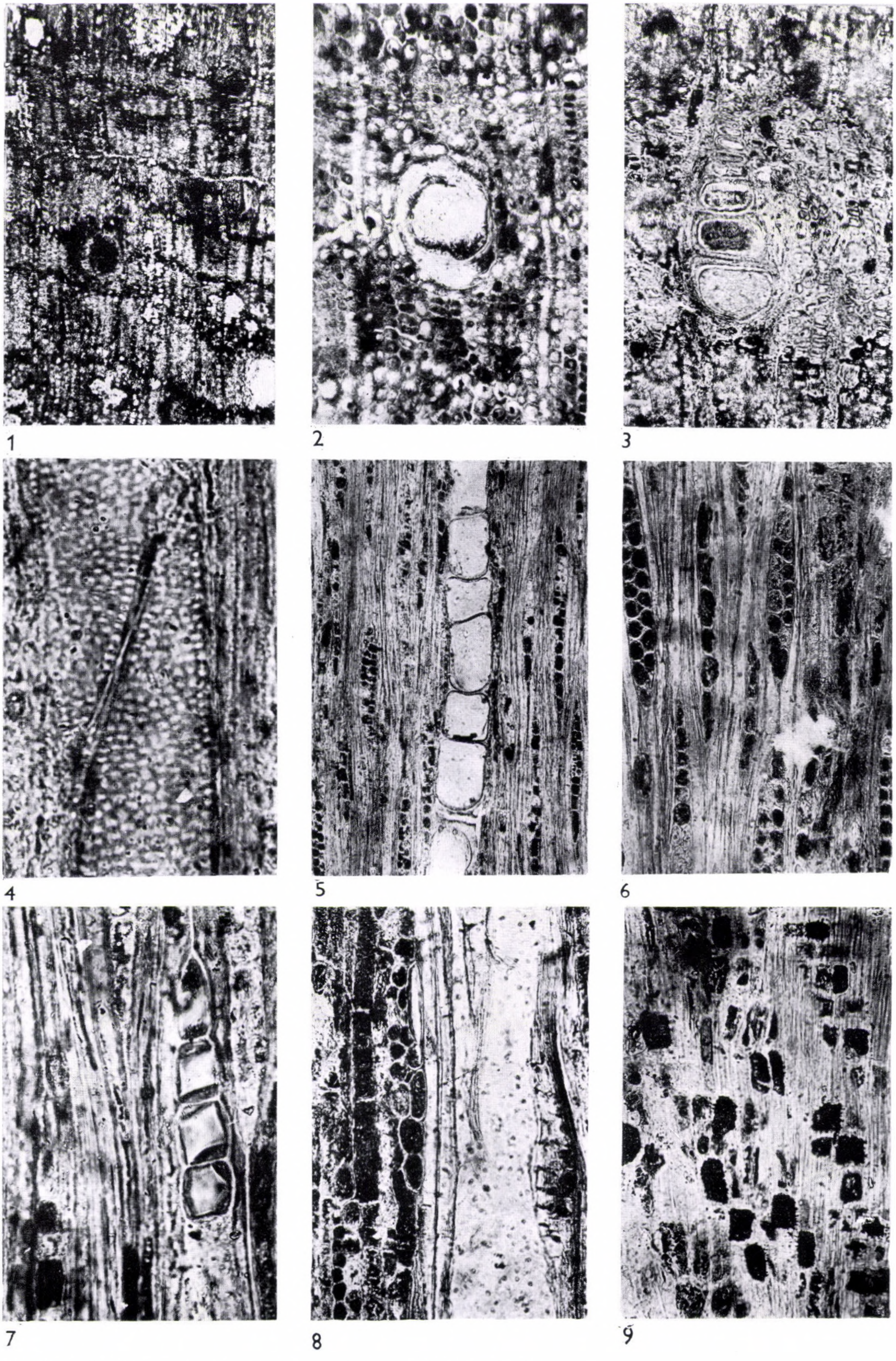
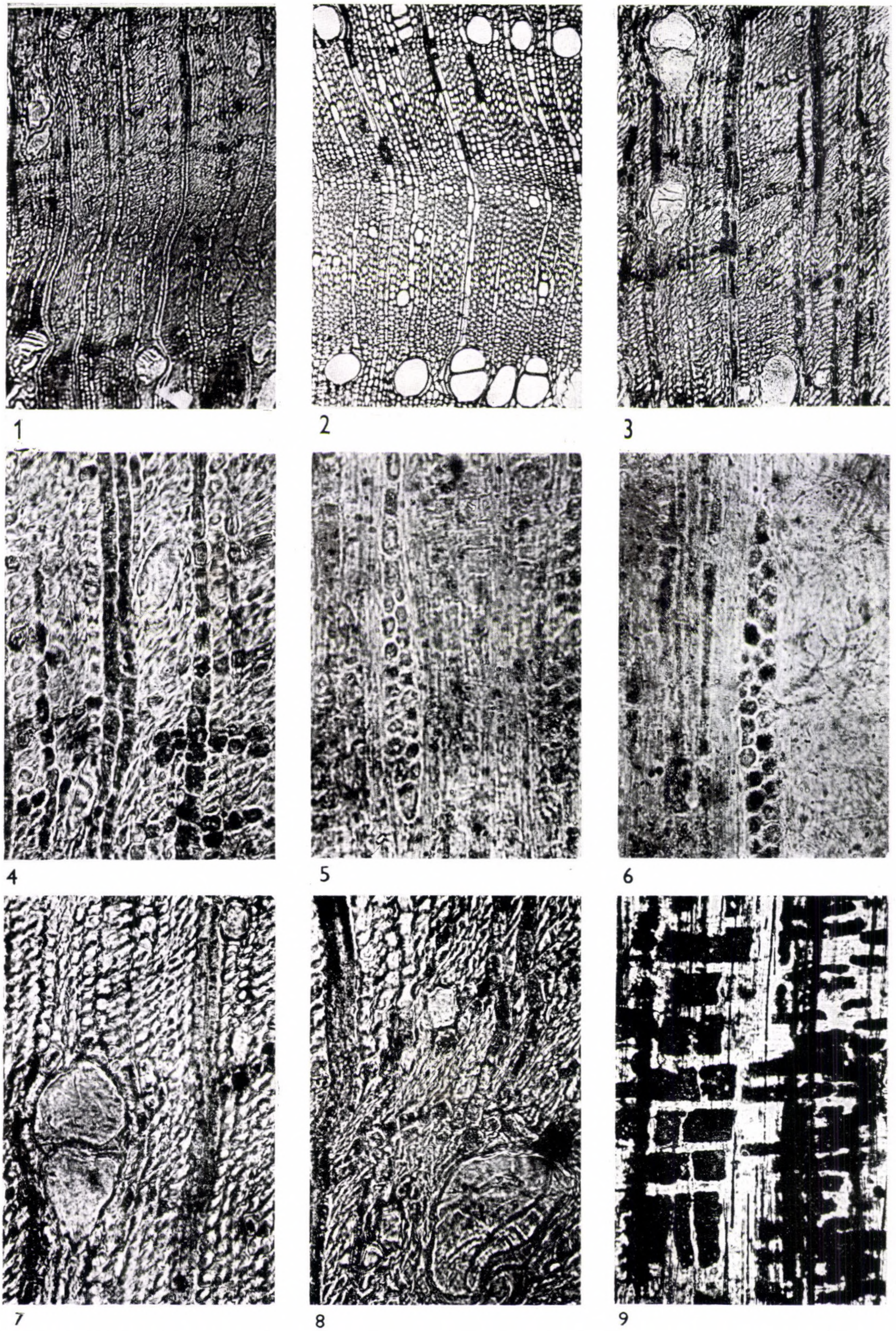
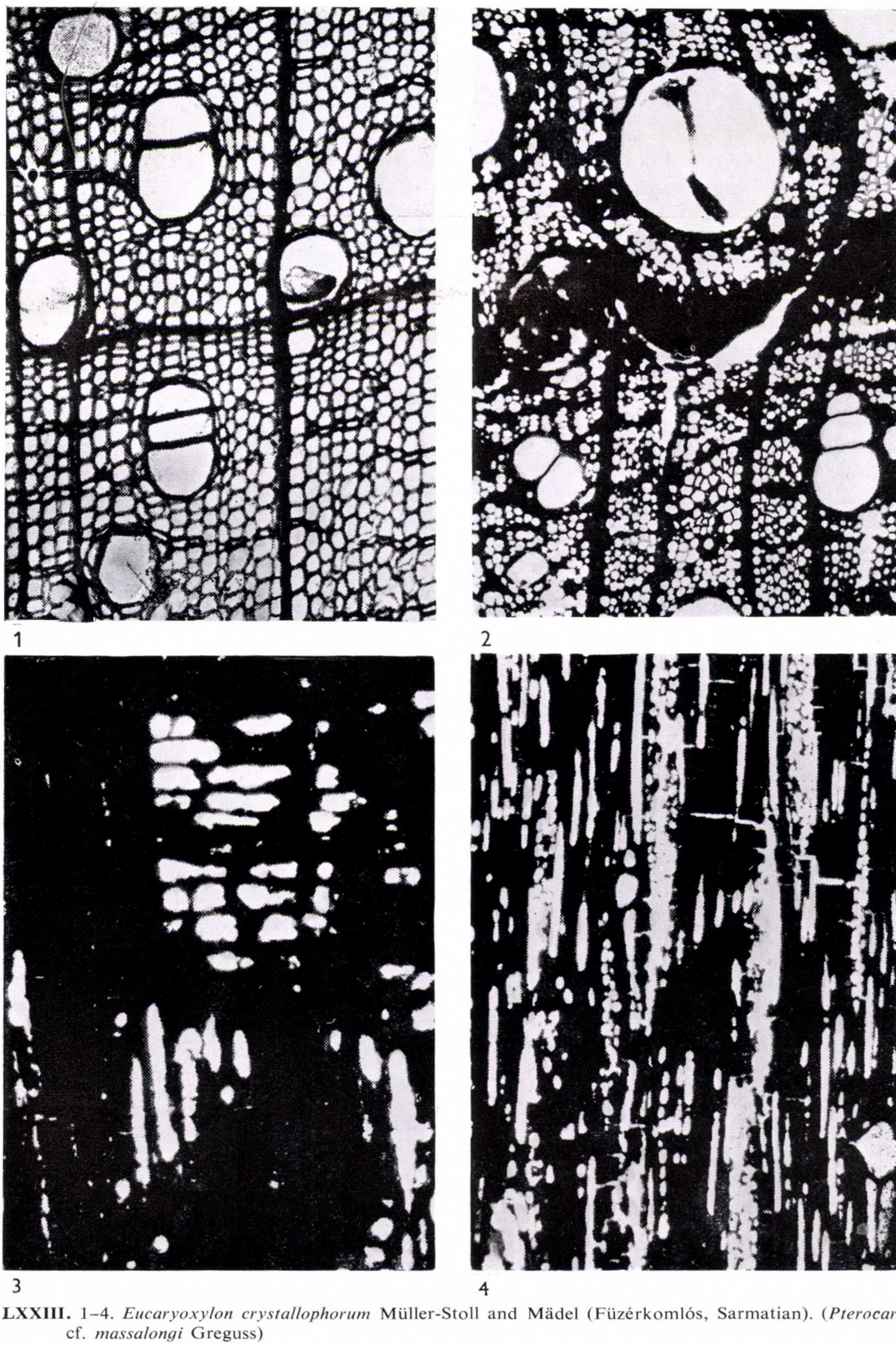
LXX. 1–4. *Pterocaryoxylon* cf. *pannonicum* Müller-Stoll and Mädel (Nemti, Lower Helvetian)



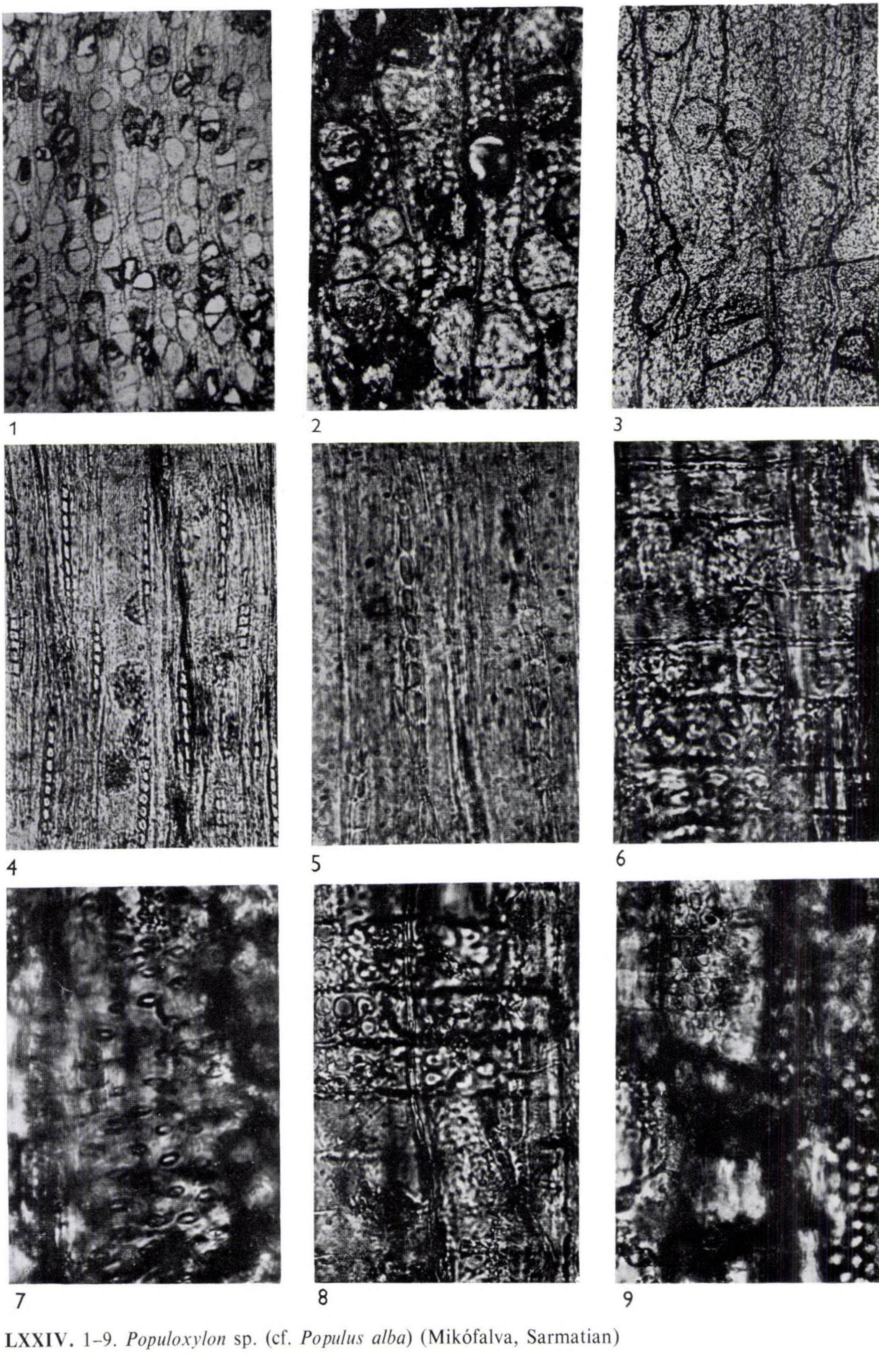
LXXI 1–9. *Pterocaryoxylon pilinyense* n. sp. (Piliny, Helvetian)



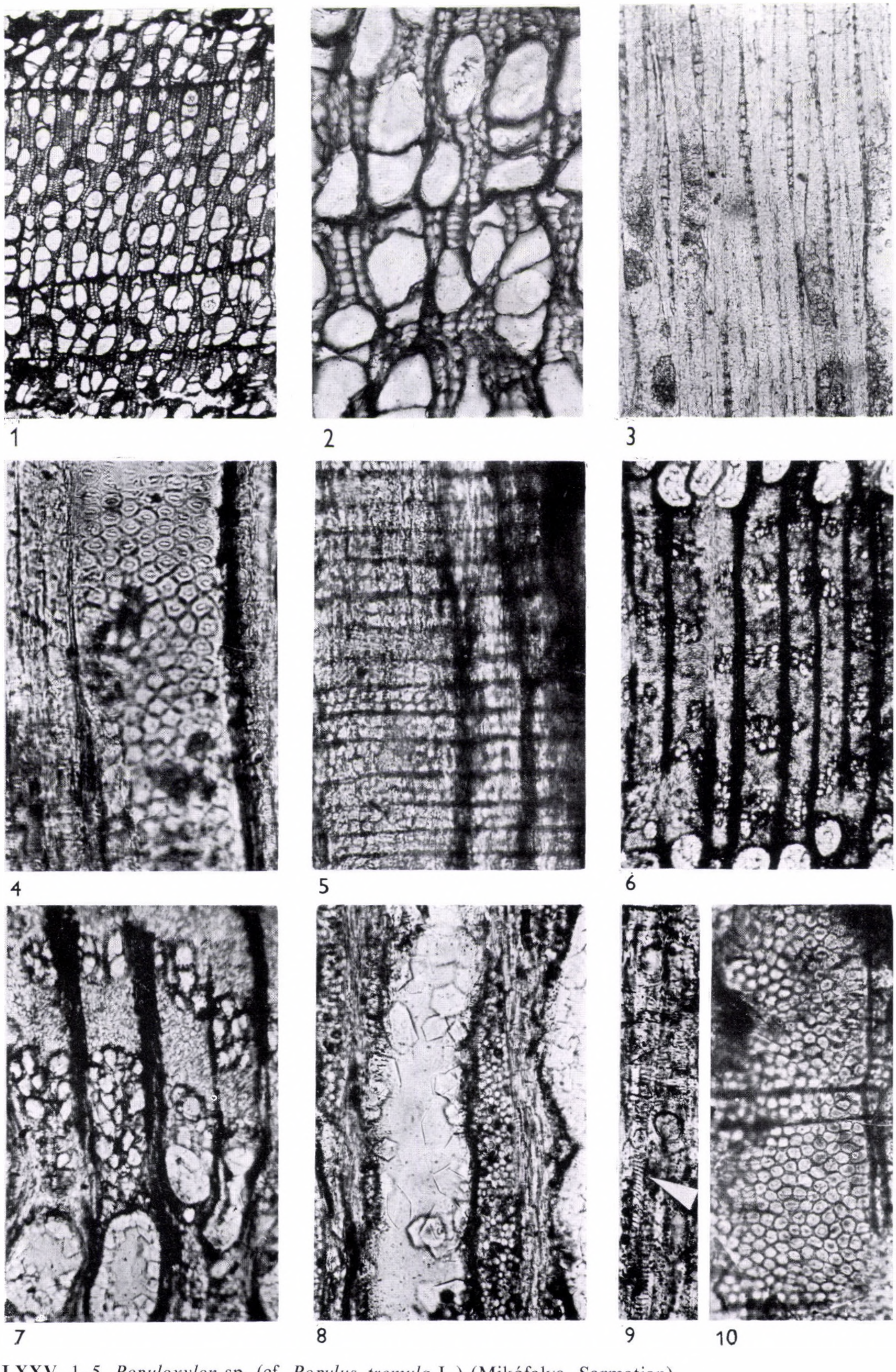
LXXII. 1–9. *Eucaryoxylon budense* n. sp. (Budapest, Lower Helvetian)



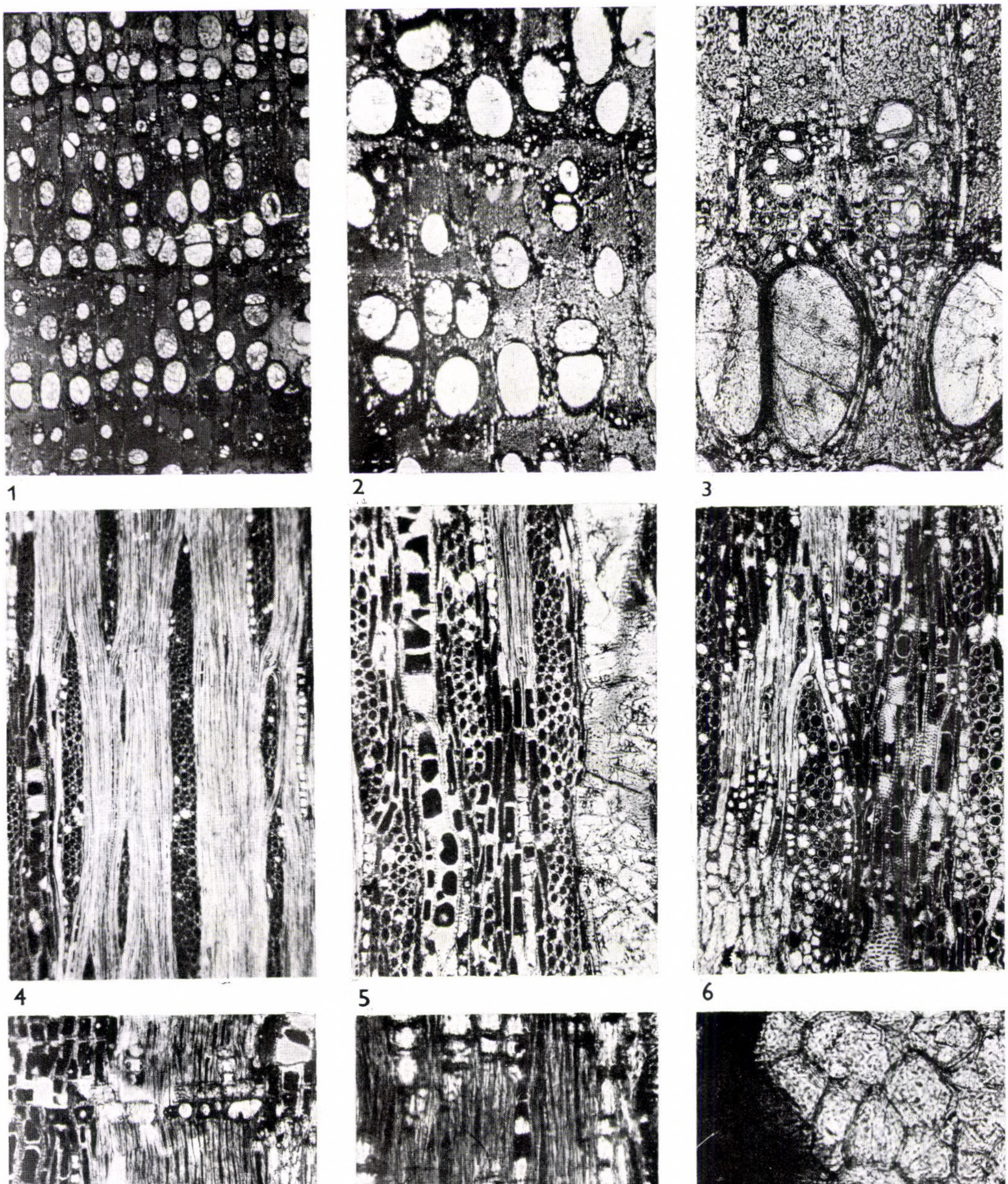
LXXIII. 1–4. *Eucaryoxylon crystallophorum* Müller-Stoll and Mädel (Füzérkomlós, Sarmatian). (*Pterocarya* cf. *massalongi* Greguss)



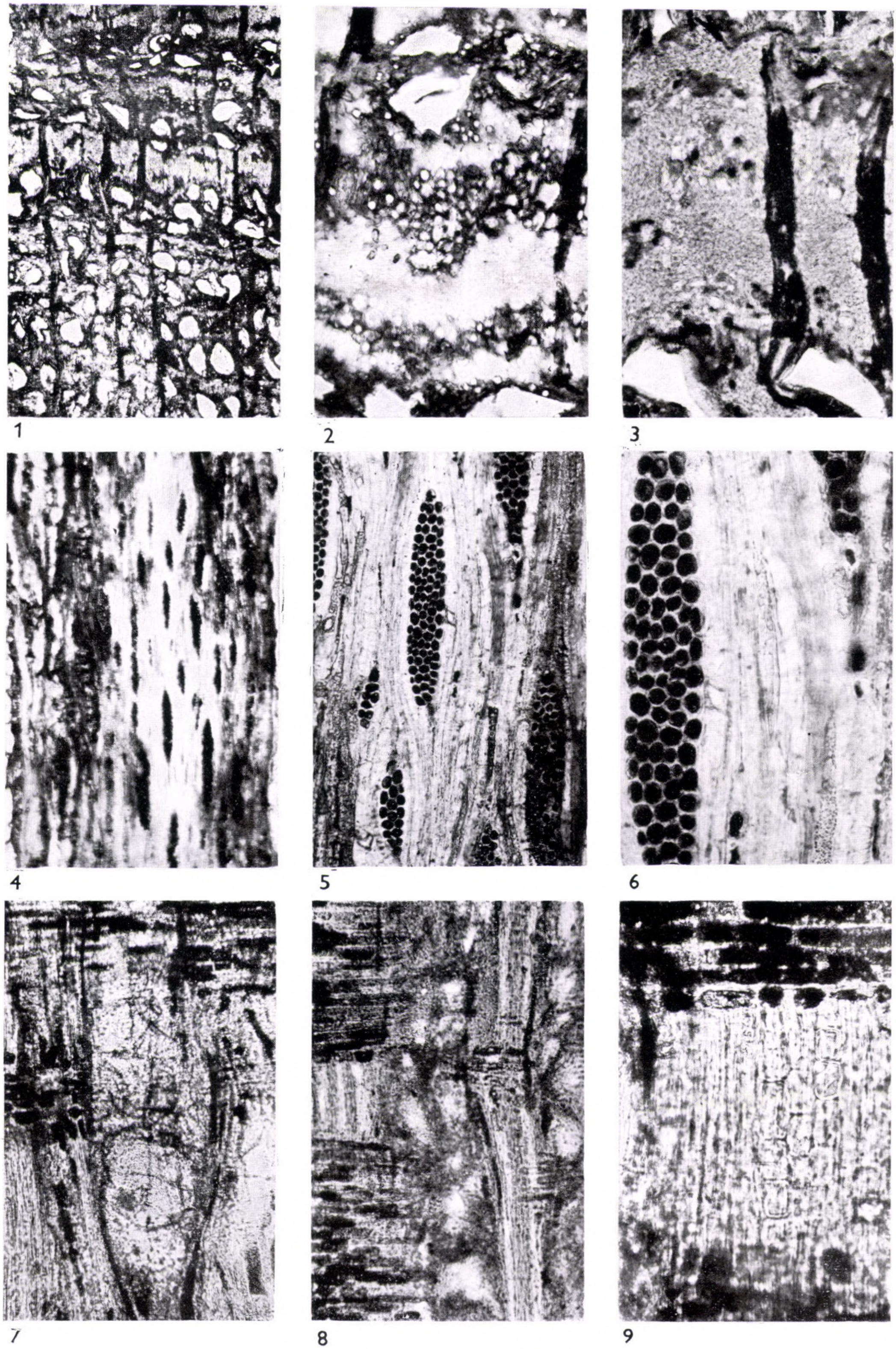
LXXIV. 1–9. *Populoxylon* sp. (cf. *Populus alba*) (Mikófalva, Sarmatian)



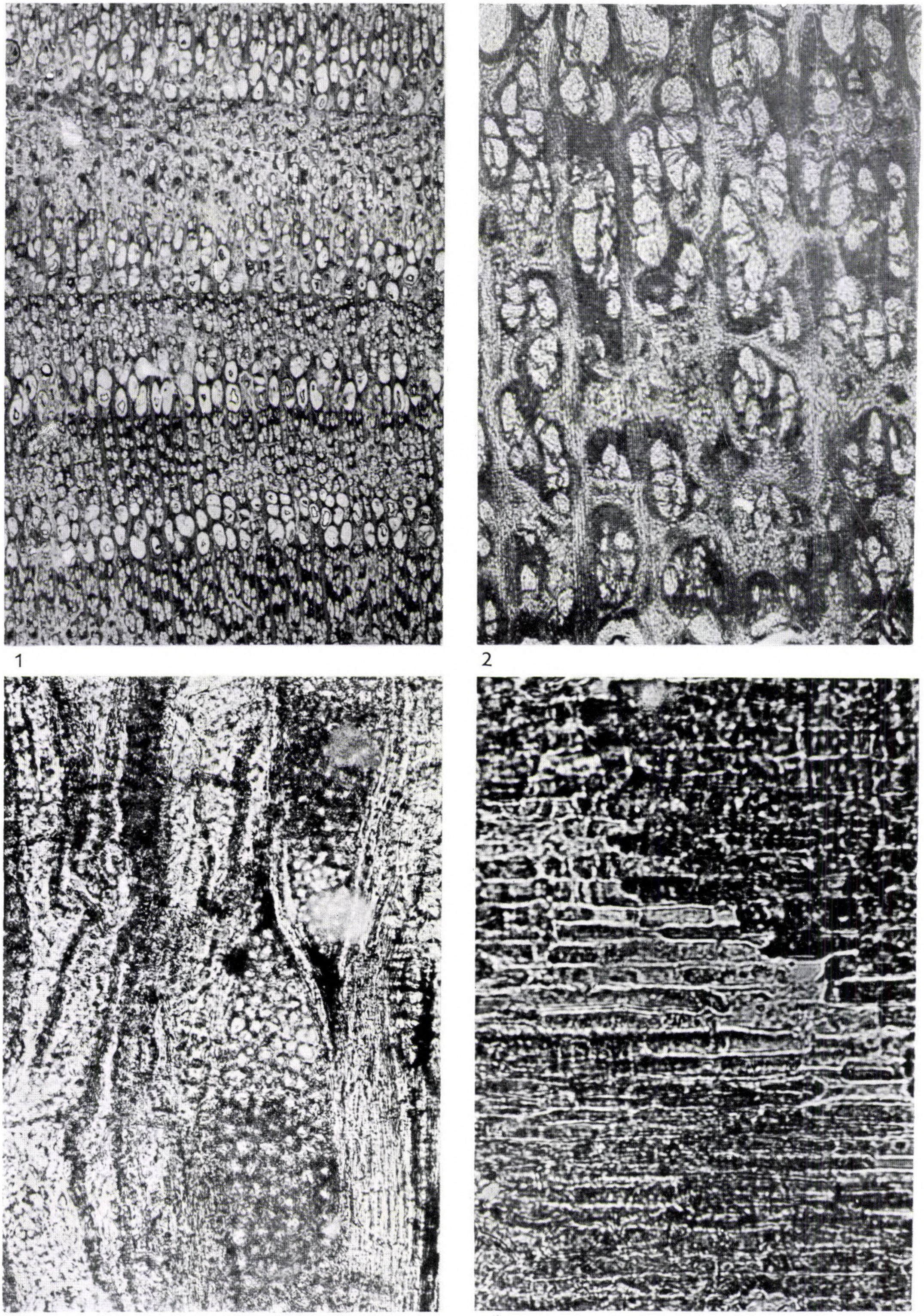
LXXV. 1–5. *Populoxylon* sp. (cf. *Populus tremula* L.) (Mikófalva, Sarmatian)
6–10. *Ulmoxylon* sp. (cf. *Ulmus scabra* Mill.) (Szigliget, Helvetian)



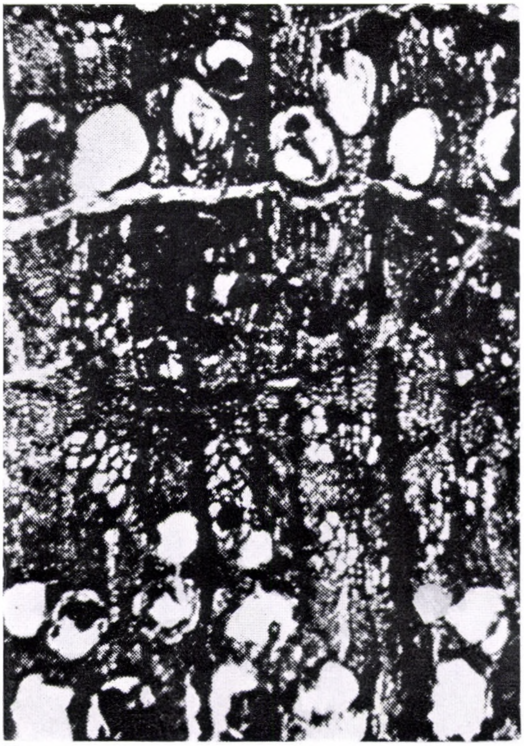
LXXVI. 1–9. *Zelkovoxylon yatsenko-khmelevskyi* n. sp. (Nógrádszakál, Lower Sarmatian)



LXXVII. 1–9. *Ulmoxylon scabroides* n. sp. (Sámsonháza, Helvetian)



LXXVIII. 1–4. *Ulmoxylon* cf. *carpinifolia* Gled. (Pásztó, Sarmatian–Pannonian)



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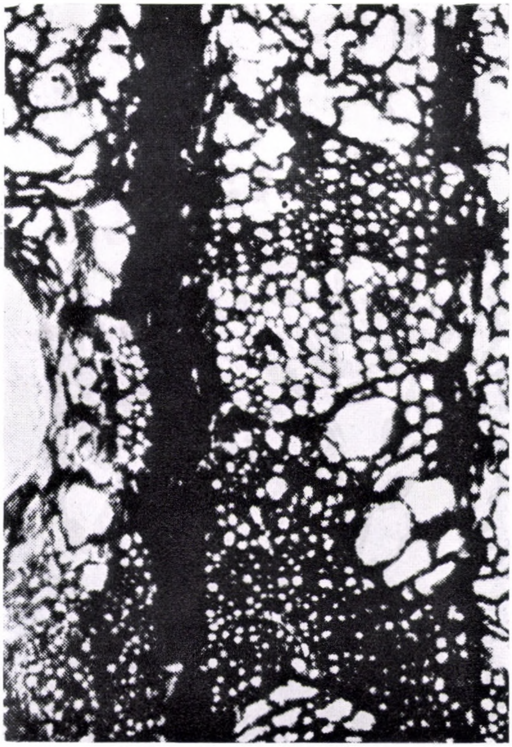

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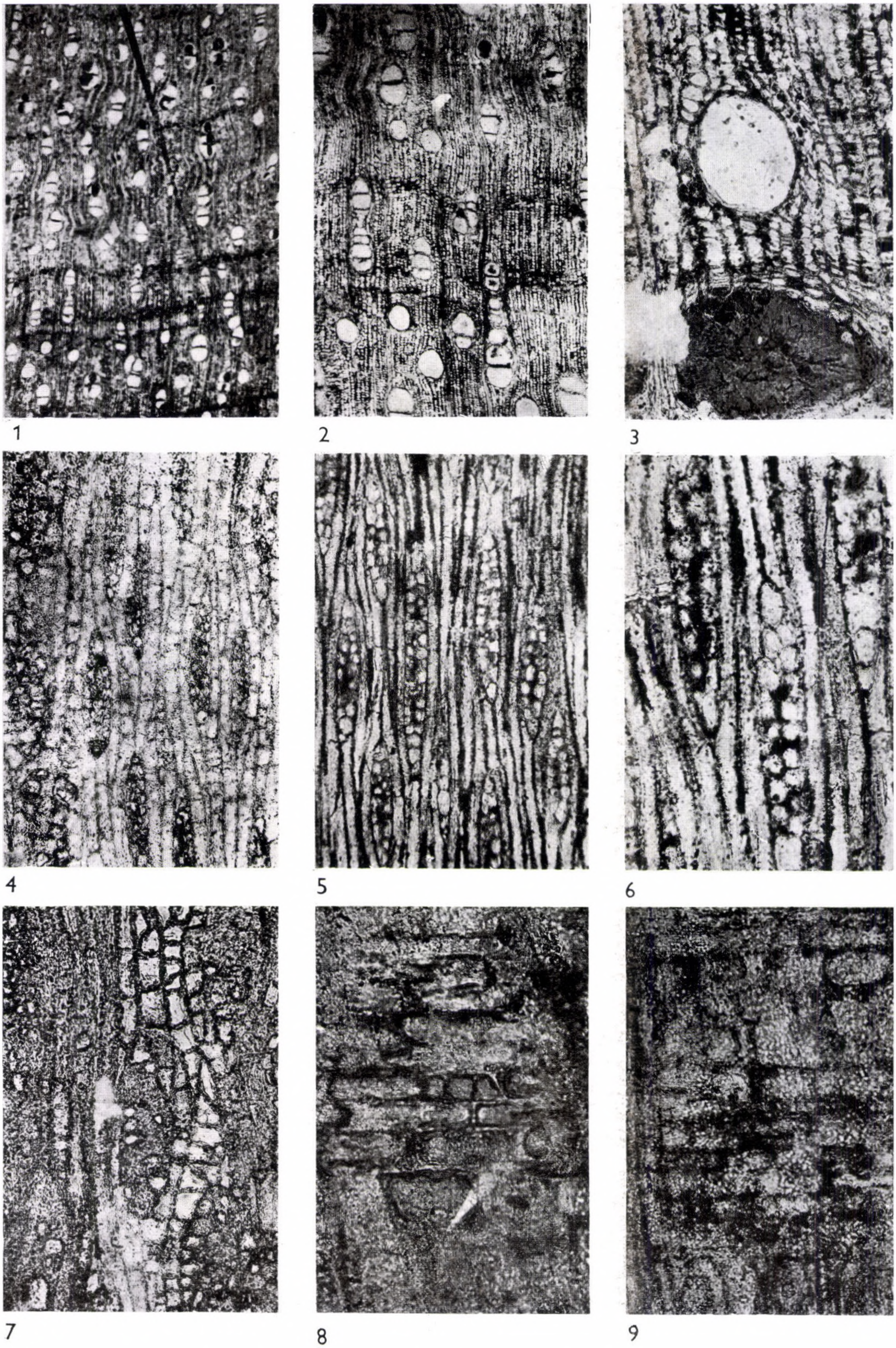
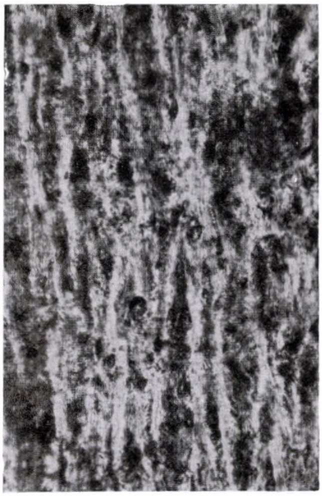
LXXIX. 1–4. *Celtixylon campestre* (Hofmann) n. comb. (Füzérkomlós, Sarmatian)



LXXX. 1–9. *Meliaceoxylon matrense* n. sp. (Mátranovák, Lower Helvetian)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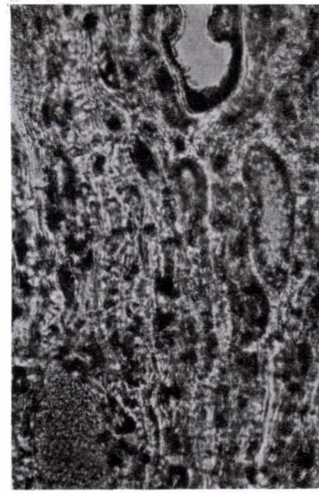
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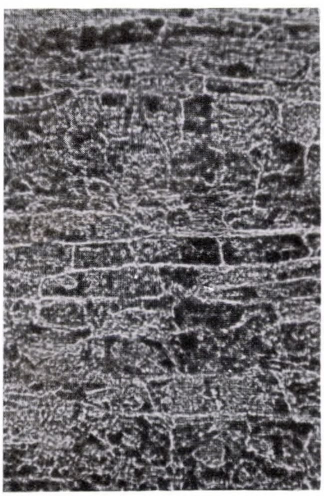
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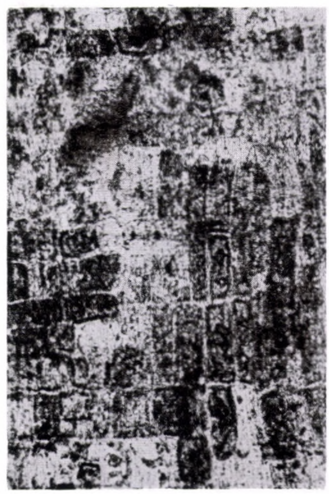
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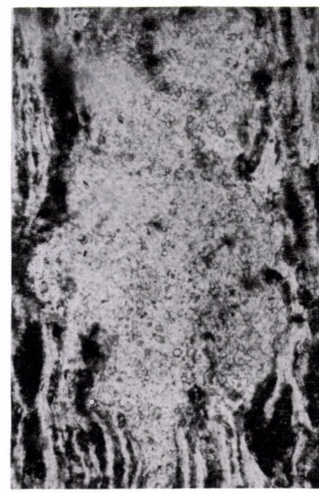
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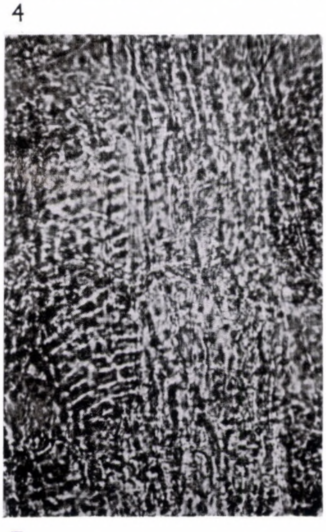
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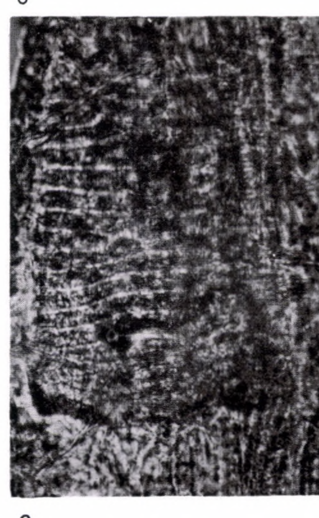
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LXXXI. 1–9. *Euphorbioxylon secretiphorum* n. sp. (Szarvaskő, Helvetian)

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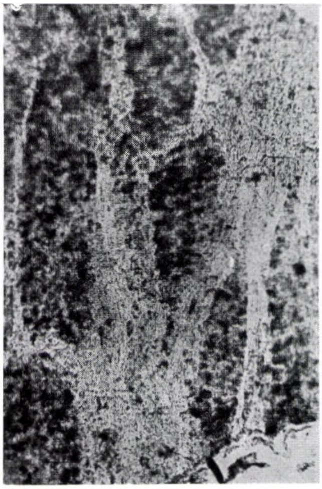

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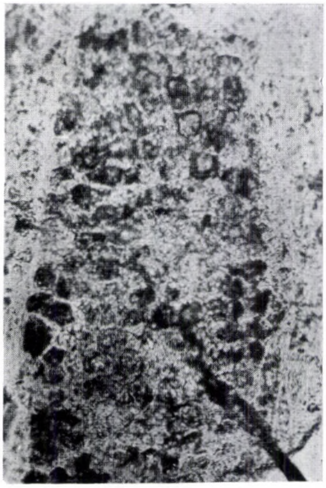

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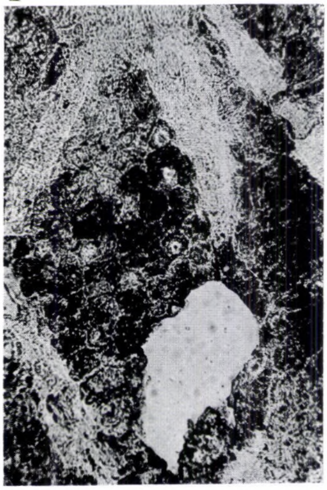

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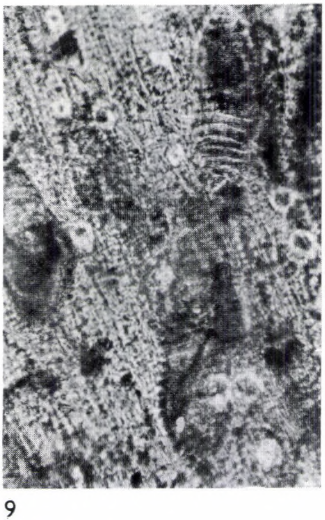

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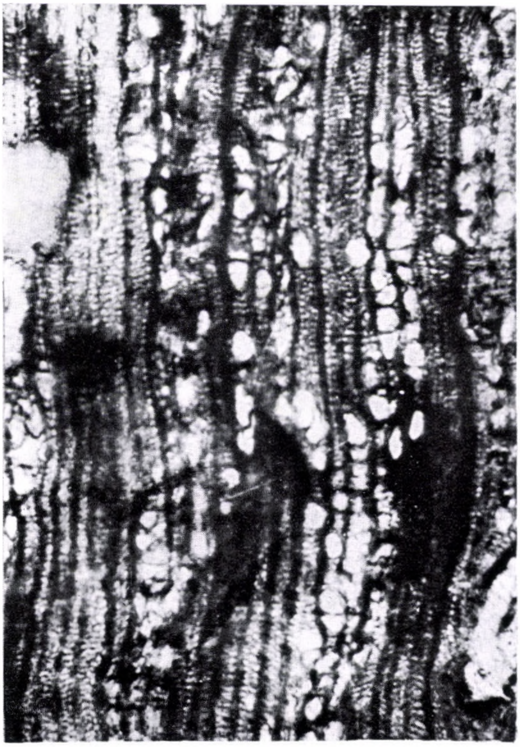
LXXXII. 1–9. *Euphorbioxylon secretiphorum* n. sp. (Szarvaskő, Helvetian)



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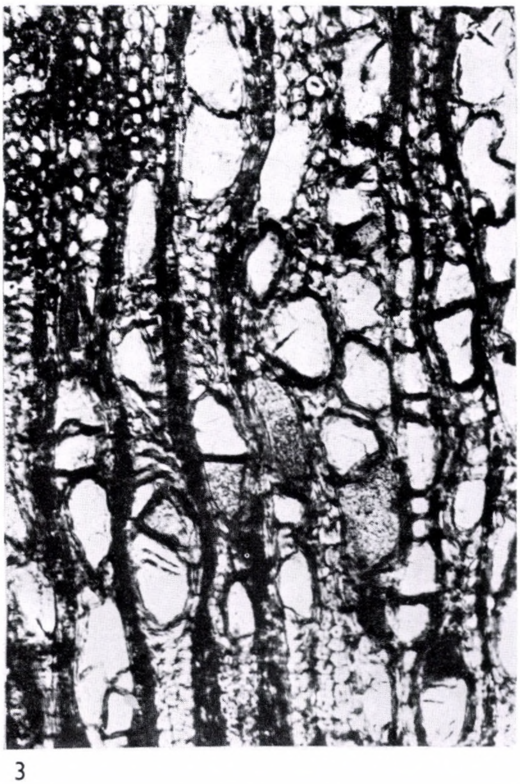

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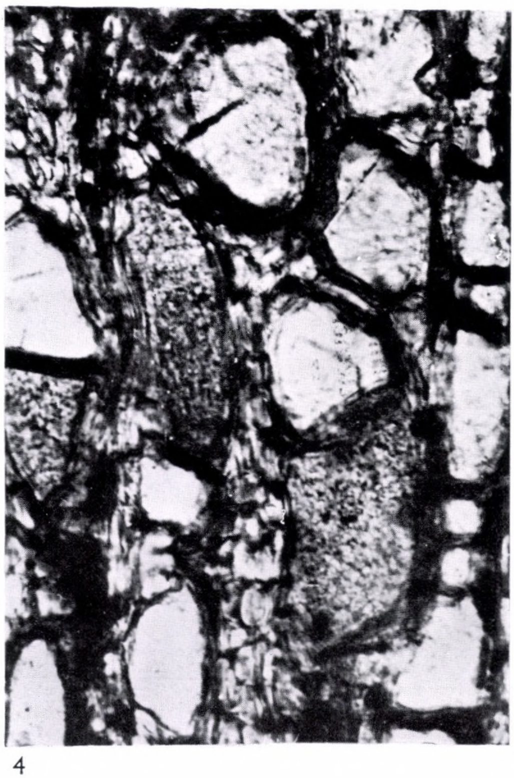

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LXXXIII. 1–4. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene)

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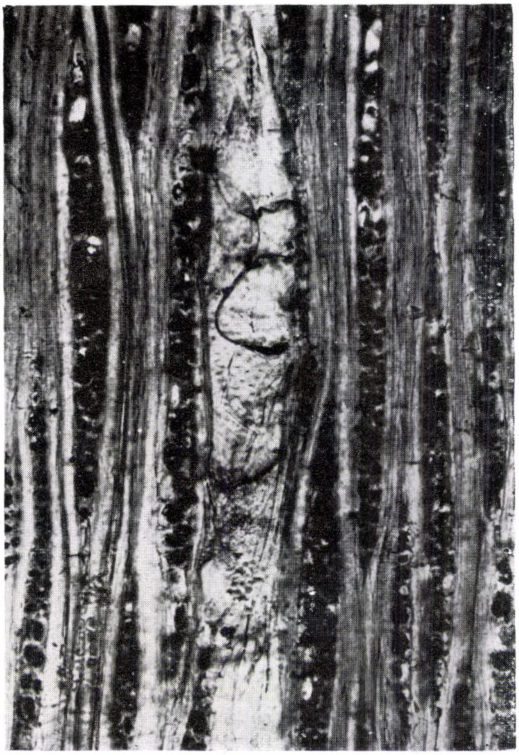

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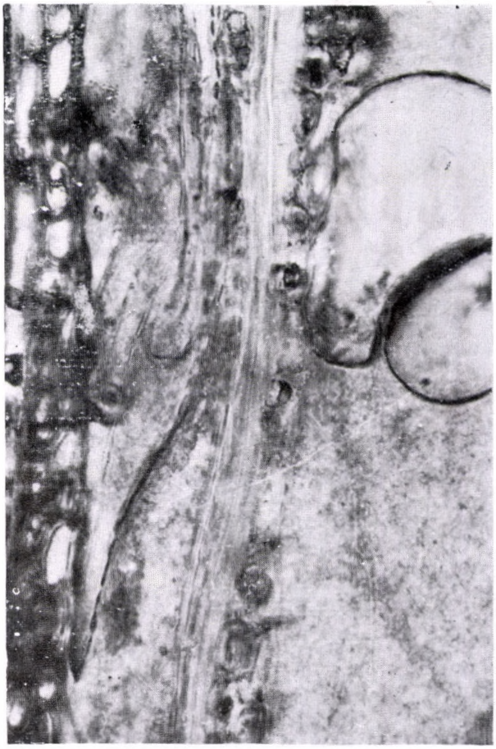
LXXXIV. 5-8. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene)



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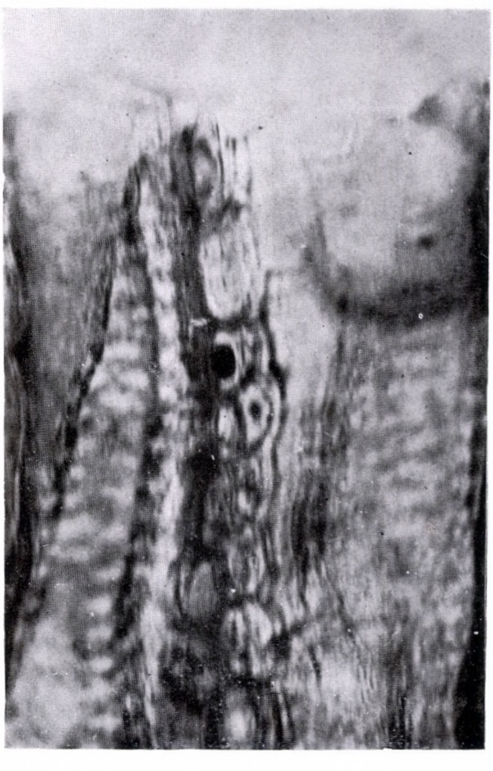


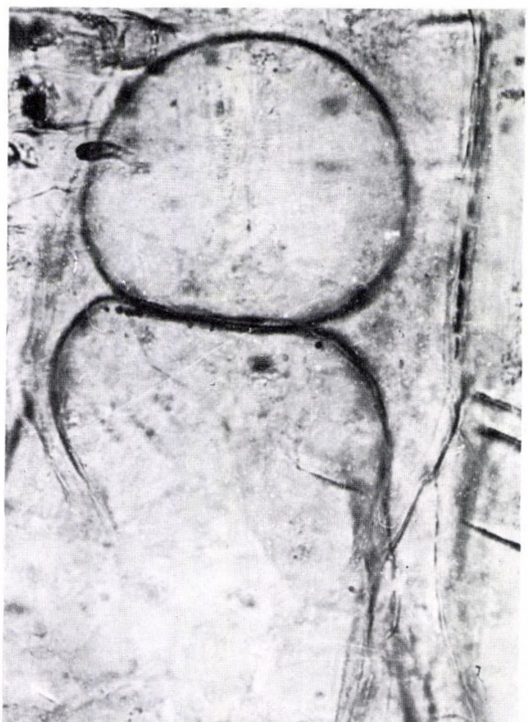
11

12

LXXXV. 9–12. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene)

13

14



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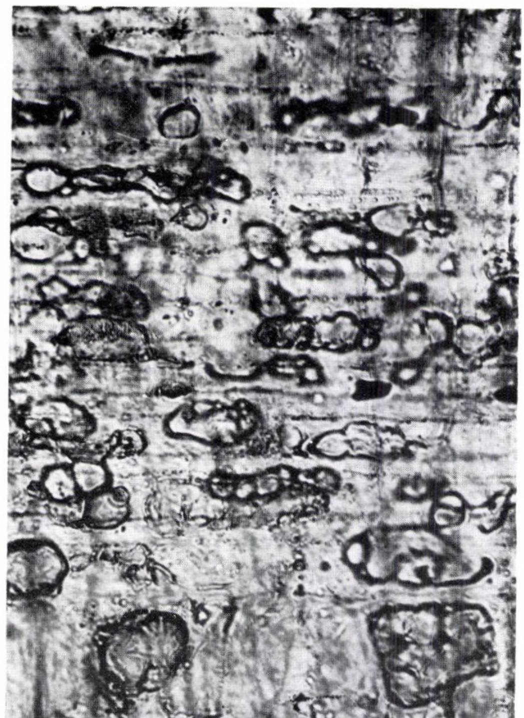
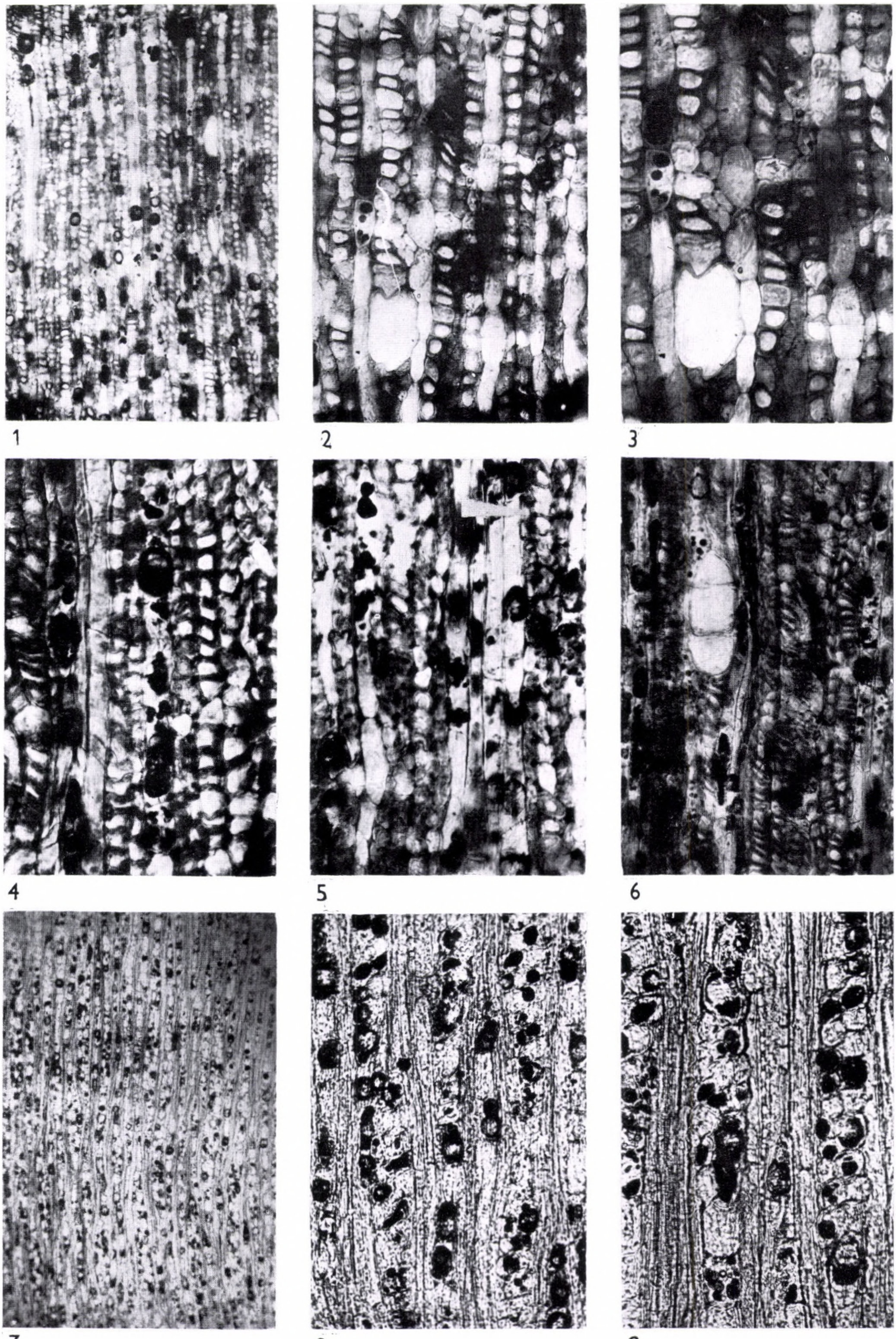
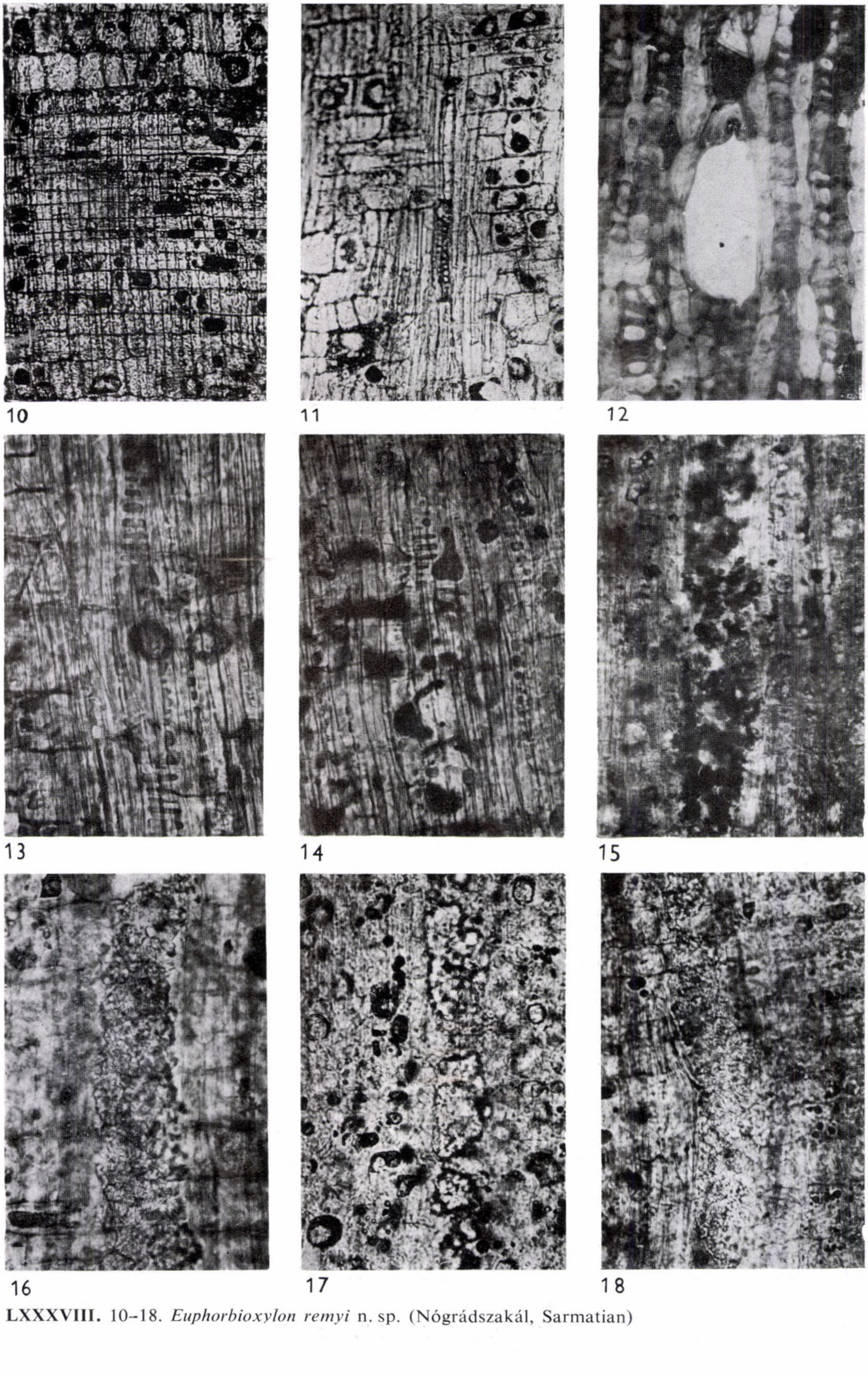


16

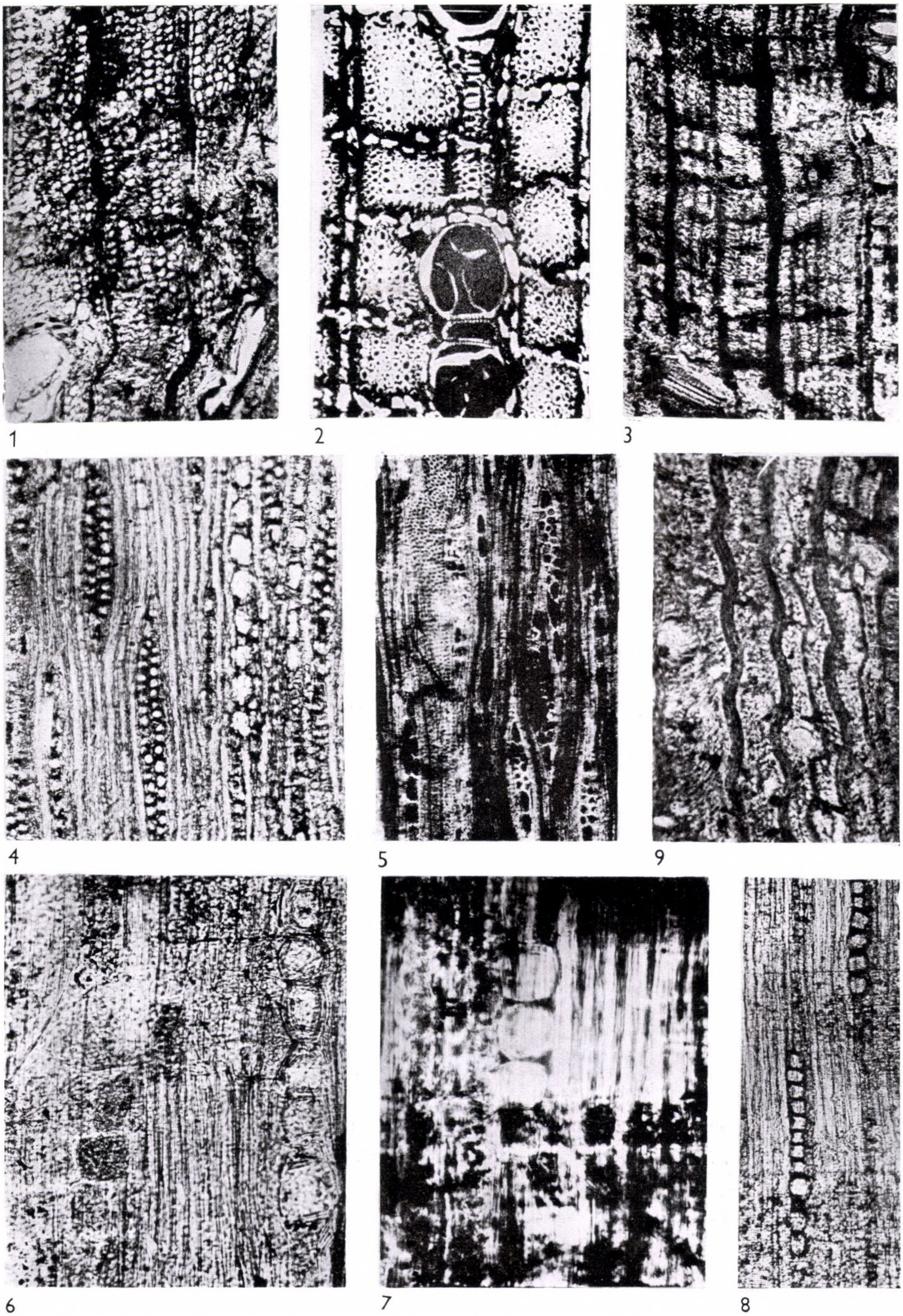
LXXXVI. 13–16. *Euphorbioxylon dorogense* n. sp. (Dorog, Oligocene)



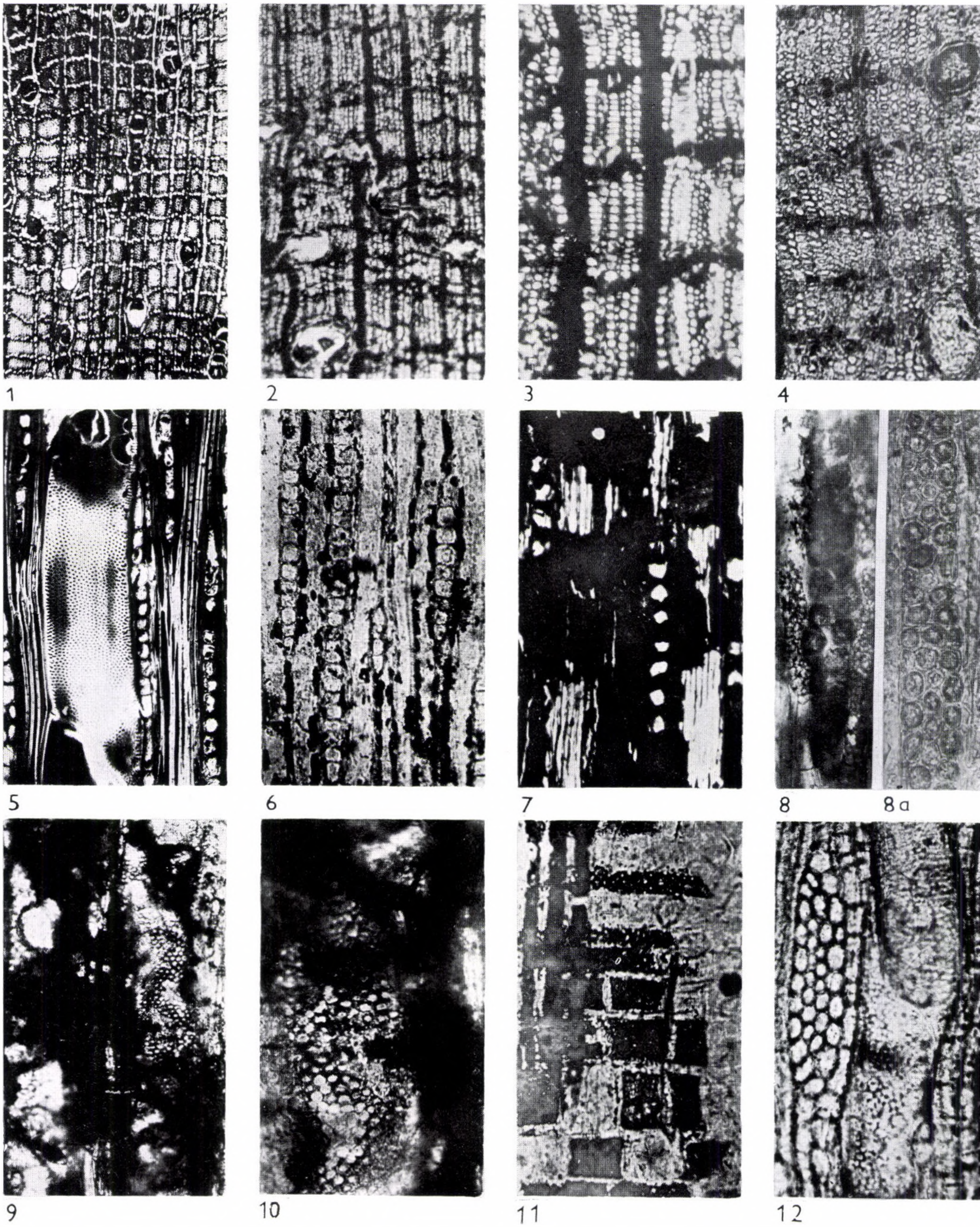
LXXXVII. 1–9. *Euphorbioxylon remyi* n. sp. (Nógrádszakál, Sarmatian)



LXXXVIII. 10–18. *Euphorbioxylon remyi* n. sp. (Nógrádszakál, Sarmatian)



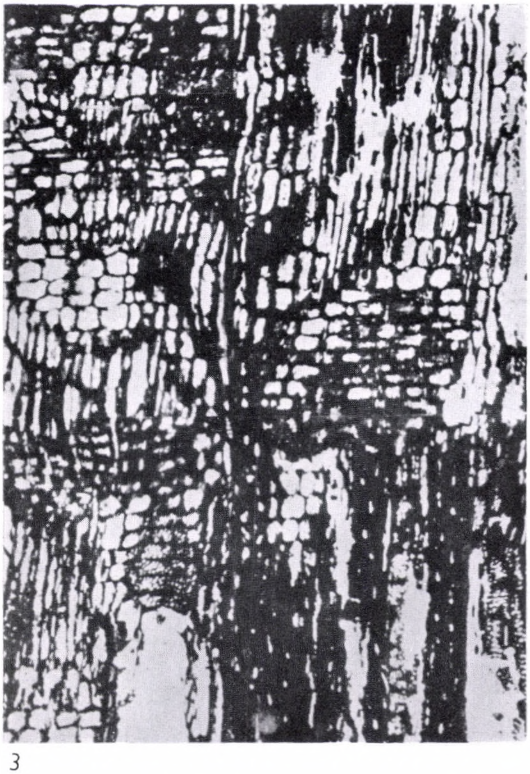
LXXXIX. 1, 4, 6 and 7. *Ebenoxylon knollii* Hofmann (Sirok, Oligocene)
3, 5, 8 and 9. *Ebenoxylon hofmannae* Greguss (Sirok, Oligocene)
2. *Diospyros lotus* L. (recent)



XC. 1, *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian)
2, 3, 6, 7, 9–11. *Diospyroxylon* cf. *ebenaster* Retz (Ipolytarnóc, Burdigalian)
4, 8 and 8a. *Diospyroxylon* sp. (Érd–Törökbálint, Helvetian)
5. *Diospyros ebenaster* Retz (recent)
12. *Ulmoxylon* sp. (Mátraverebély, Helvetian)

1

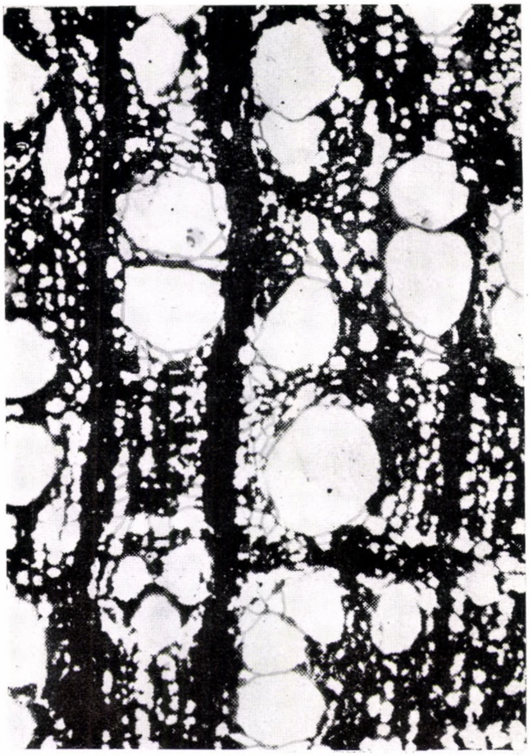
2



3

4

XCI. 1–3. *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian)
4. *Fraxinoxylon* cf. *Fraxinus excelsior* L. (Pestszentlőrinc, Pleistocene)



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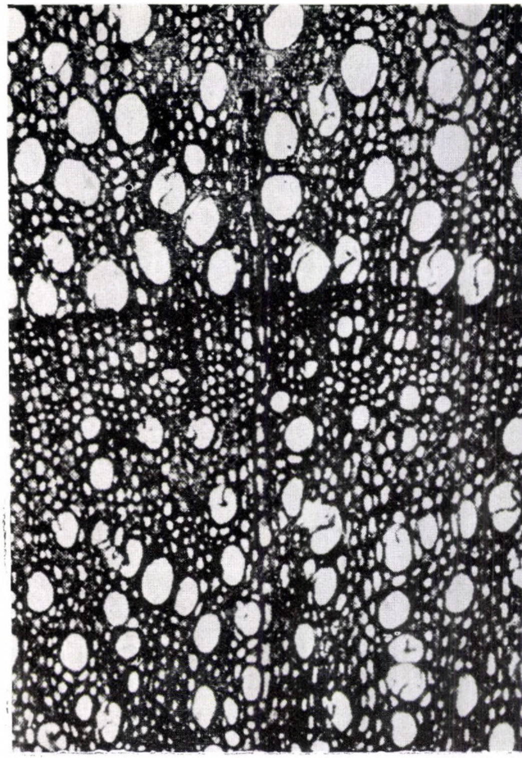

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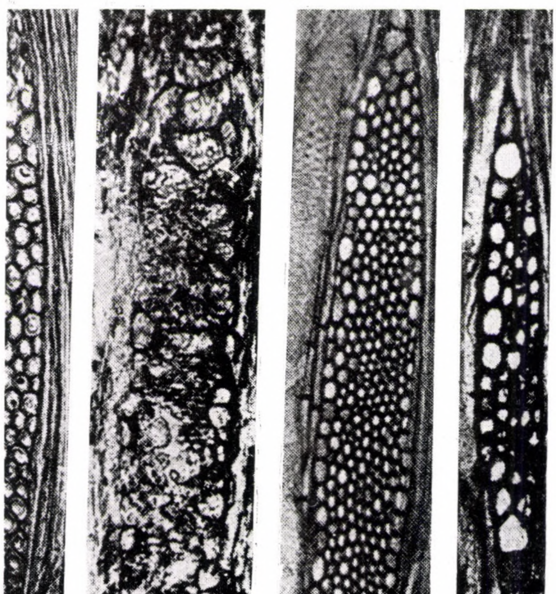
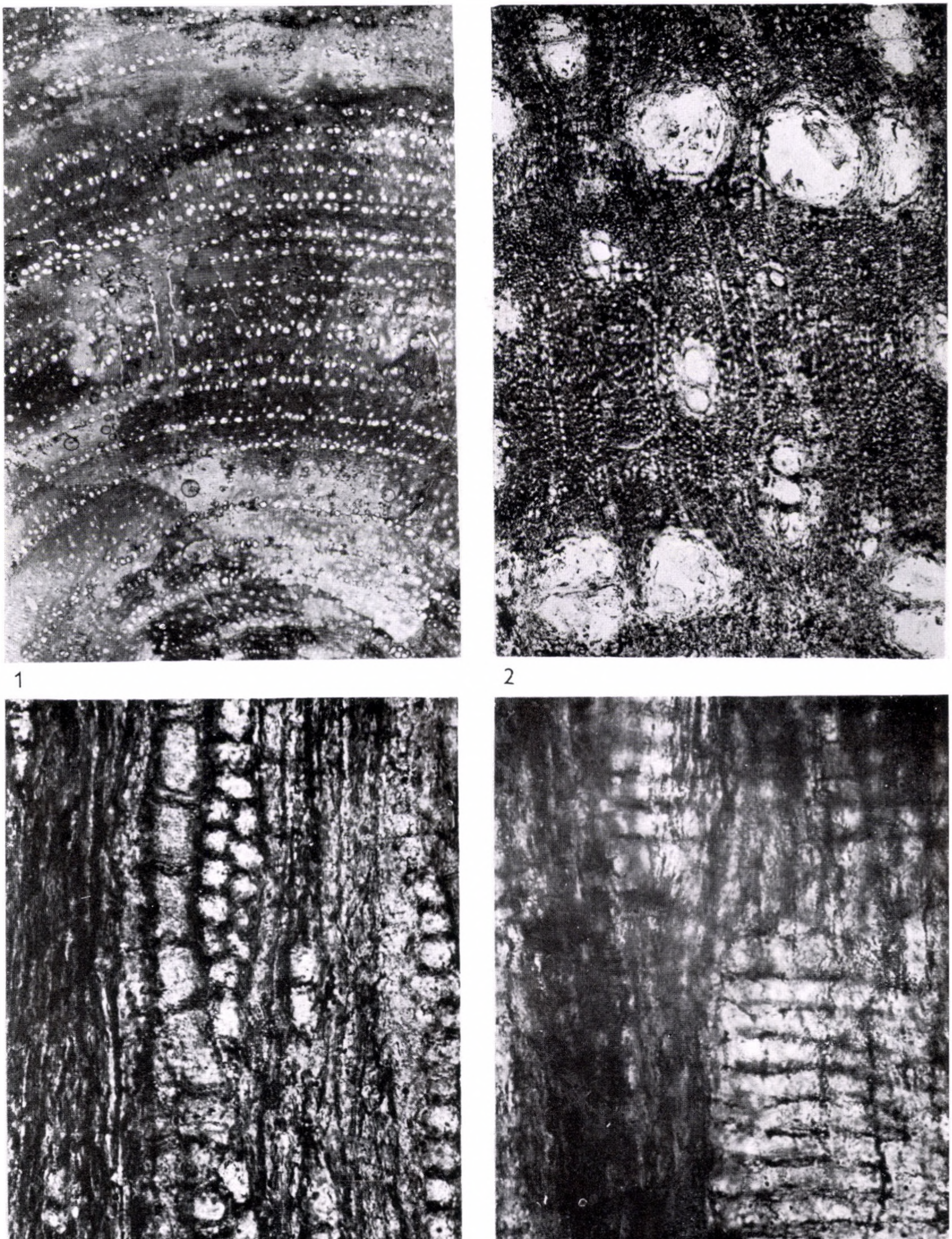


3a b c d

XCII. 1. *Fraxinoxylon komlósense* Greguss (Füzérkomlós, Sarmatian)
2. *Erica arborea* L. (recent)
3a. *Ulmus campestris* (recent)
3b. *Celtioxylon palaeohungaricum*
3c. *Celtis australis* (recent)
3d. *Zelkova keakii* (recent)



XCIII. 1–4. *Fraxinioxylon* cf. *Fraxinus excelsior* L. (Pestszentlőrinc, Pleistocene)

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