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EARLY MIOCENE FLORA OF THE CYPRIS SHALE (WESTERN BOHEMIA)

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Abstract. The Early Miocene flora of the Cheb and Sokolov Basins (W. Bohemia) preserved in the Cypris Shale overlying the lignite seams has been studied on the basis of leaf, fruit and seed megafossils. As a whole 126 taxa have been stated, of them 1 Charophyte, 2 Mycophytes, 1 Bryophyte, 5 Pteridophytes, 11 Conifers and 106 Angiosperms. Three new combinations, *Ocotea hradekensis* (KVAČEK et BŮŽEK) comb. n., *Ternstroemia sequoioides* (ENGELHARDT) comb. n. and *Cladiocarya chomutovensis* (HOLÝ et BŮŽEK) comb. n. have been proposed. Taphocenoses in the coal clay and erosion fillings in the seam roof reflect transition between swamp and riparian forests and marshes. Those in the shale facies include mesophytic forest elements and herbaceous community of facultative halophytes. A regime of drainless, periodically eutrophized and partly salty lake can be assumed. A higher share of thermophilous elements (incl. *Mastixia*) attests to subtropical climate with variable precipitations. The flora is dated by mammals to the zones MN 4 b and 5, i.e. Ottnangian to Karpathian.

■ Terrestrial megaflora, palaeoecology, Central Europe, Early Miocene.

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Introduction

The three Tertiary lignite basins in NW Bohemia differ from each other by their facial development and stratigraphy. The largest North Bohemian Basin became a lake which drained northwards after the deposition of lignite seams . The two others, the Sokolov and Cheb Basins, transformed, on the other hand, into a shallow drainless lake. Its filling is built up by a bitumenous claystone. This very characteristic deposit was defined as a stratigraphical unit by Reuss (1852) and named the Cypris Shale (Cypris Schiefer) according to the abundant occurrence of ostracods *Cypris angusta* REUSS. As in other deposits of this kind, the claystone has yielded, in addition to ostracods, other fossils, namely insect, fish and other vertebrate fauna, as well as plant remains.

The Sokolov (previously Falknov) Basin has been opened by numerous mines since the last century. The Cypris Shale complex is easily accessible there, but has been partly removed by extensive mining activities. In the Cheb Basin, except for scanty outcrops, only boreholes afforded opportunities for collecting.

The majority of the plant fossils described in this paper, include new material. Field work has been conducted since 1958 at the site Mokřina. The main collections were made in the year 1962 at

Dolnice (in cooperation with O. Fejfar) and the mine Dukla, Habartov (in cooperation with N. Obrhelová), and continued in 1967 (boreholes of the Uranium Geological Prospection, J. Morávek, Z. Plaček) and with the majority occurring between 1971 and 1979 (boreholes of the geological prospection Geoindustria, A. Pazdera, V. Kolája, J. Slámová, J. Václ).

In this way, over 8000 specimens of plant megafossils were gathered and evaluated. In addition, some older collections in the National Museum and the Sciences Faculty of the Charles University, Prague, and Staatliches Museum für Mineralogie und Geologie, Dresden were at our disposal. The Czech manuscript version (Bůžek, Holý and Kvaček 1980) was completed in 1979. The most unfortunate circumstances of the death of two of the authors (Č. Bůžek, F. Holý) caused a great delay in preparing the entire paper for print. Not all specimens could be located and some others were secured by chance. The determination of the carpological record was mostly done by the late F. Holý, the cuticular study was carried out by Z. Kvaček, and the rest of the research was done by the late Č. Bůžek, who also participated in the palaeocarpology.

We would like to thank all who supported or participated on the collections and made available geological data, particularly our colleagues from the geological prospection Geoindustria, J. Václ and A. Pazdera. Our thanks are also due to the staffs of the Czech Geological Survey and the Geological Institute of the Academy of Sciences, Prague for technical assistance. We appreciate suggestions and cooperation that improved the manuscript by E. Knobloch, Prague, D. H. Mai, Berlin and H. Walther, Dresden.

History of palaeobotanical research

The only work dealing with the Cypris Shale flora was published by Engelhardt (1880). The first data (Reuss 1852, Jokély 1857, Novák 1874) or some later notes (Růžička and Beneš 1951, Růžička 1956, Kulawczyková 1957, Obrhelová and Obrhel 1965, Obrhelová 1966) presented mostly lists of plant taxa without illustrations or descriptions. Taxonomical treatments of individual species can be found in monographs by Unger (1860), Menzel (1901), Procházka (1952), Procházka and Bůžek (1975), Obrhel (1964), Bůžek, Holý and Kvaček (1967), Kvaček (1971, 1972, 1979), Jähnichen, Mai and Walther (1977), Kvaček, Bůžek and Holý (1982), Bůžek and Holý (1981), Bůžek and Konzalová (1983) and Kvaček and Walther (1988).

Palynological data are scattered in several papers, reports, theses (Rudolph 1935, Pacltová and Žert in Fejfar et al. 1955, Pacltová and Žert in Zoubek et al. 1963, Ganguli 1966, Deb 1973, Pacltová and Ganguli 1968, Pacltová and Pflug 1973, Pflug 1975, Konzalová 1977, Konzalová in Pazdera 1978, Konzalová and Stuchlik 1983), but a monograph is not available so far. The diatome flora was briefly described by Řeháková (in Ambrož, Šantrůček and Mrázek 1958).

Some recent publications deal with stratigraphical position and correlation of the Cypris Shale flora (Knobloch et al. 1975, Bůžek et al. 1982, Bůžek et al.1988) and vegetational reconstructions (Bůžek, Holý and Kvaček 1987). Otherwise only preliminary contributions (Bůžek 1977, Kvaček and Holý 1977, Holý and Bůžek 1977, Knobloch and Konzalová 1978) or unpublished reports (Konzalová et al. in Pazdera et al. 1978, Bůžek and Kvaček in Václ et al. 1977, Bůžek, Holý and Kvaček 1980), mostly in Czech, have been available.

Geological setting

The Sokolov and Cheb Basins (Figs 1-3) represent the westernmost extension of lignite-bearing Tertiary deposits in NW Bohemia. The stratigraphy of both regions is similar except for the Vildštejn Formation of the Pliocene age, which is limited only to the Cheb Basin (Bůžek et al. 1982, 1988).

The Cypris Shale represents a deposit of mostly well bedded, bitumenous claystone, up to 180 m thick immediately overlying the Main Seam of the Cheb Basin and the Antonín Seam of the Sokolov Basin. The sedimentation of lignite may pass continuously into pelitic facies, or may be interrupted by a short hiatus (Ambrož 1958, Hokr 1961). The extent and facial differentiation of the Cypris Shale is larger in the Cheb Basin. There the main part is generally built up of typical bitumenous bedded claystone with thin sapropelitic, finely bedded ("foliaceous") layers, and at some

Fig. 1. Geographical position of the studied areas in the Czech Republic.

places also with pelocarbonate or tuffaceous or even diatomaceous interbeds. Southwards and westwards, the basal part becomes more sandy. Sand layers may interchange with claystone, and the whole sequence, the so called variagated facies sensu Ambrož (1958), become reddish or greenish in colour.

The Main Seam of the Cheb Basin is discontinuously distributed and forms three partial basins. The transition between the lignite and the Cypris Shale is sharp in the eastern part. Westwards the base of the shale turns darker and gradually become lignite clay, which is partly micaceous or sandy. This development is particularly characteristic of the deep western part, called the "corridor" of Františkovy Lázně, where the lignite clay in the roof of the Main Seam is up to 20 m thick. This level is genetically connected with coal-forming sedimentation and is similar to the interseam clay layers. In the area between Pomezí and Cheb, darker micaceous sandy clay may represent mere equivalents of the Main Seam. This is, in our opinion, the position of the mastixioid flora of Františkovy Lázně recovered by Haidinger (1839), described by Unger (1850a, 1864, 1866) and revised by Kirchheimer (1939, 1941b).

The development of the Cypris Shale in the Sokolov Basin is more monotonous. Psammitic facies is limited to a small area at Čankov. The boundary between the Antonín Seam and the clay-

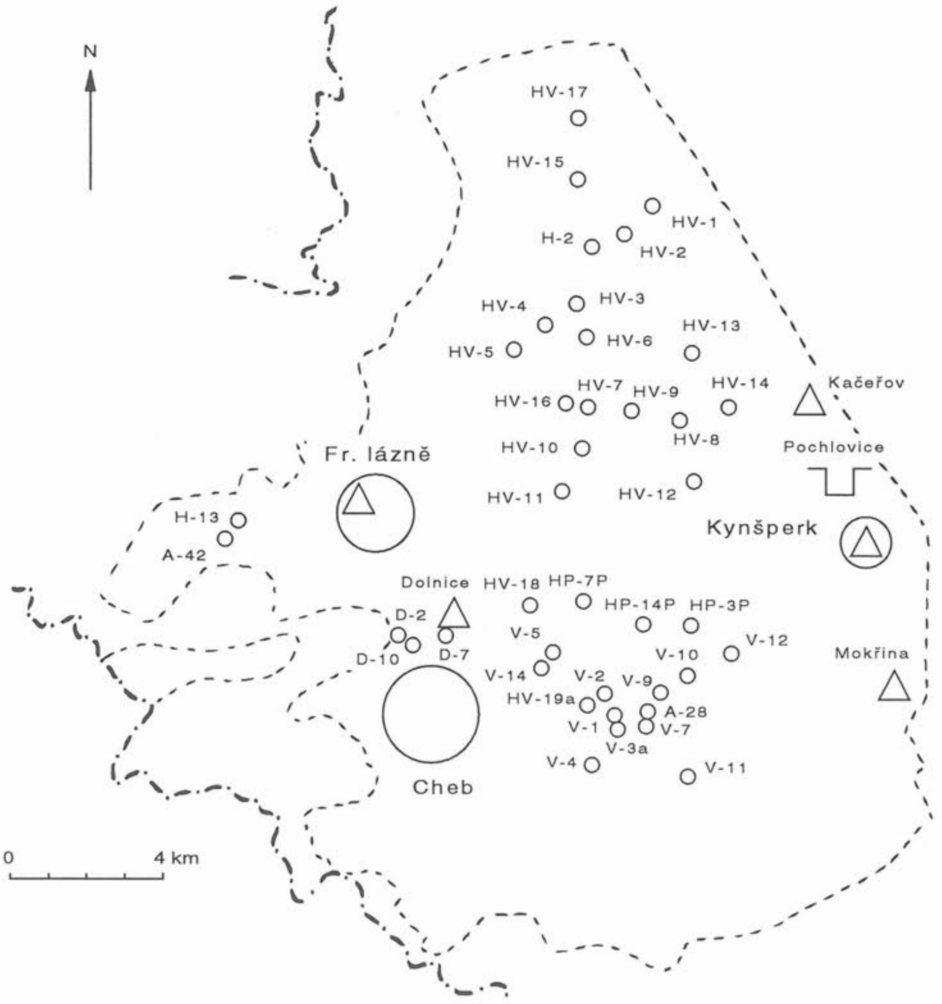

Fig. 2. Collection sites in the Cheb Basin (circle - core, triangle - outcrop, Pochlovice - abandoned mine Boží Požehnání).

stone is usually sharp, rarely connected with a layer of darker clay. The upper surface of the seam may include erosion psammitic fillings, which belong, in fact, to the Cypris Shale sedimentation cycle and yielded a carpological record, described in this paper. In the central part of the Sokolov Basin, a complex of grey kaolinic clay of uncertain origin (Hokr 1961) is developed just above the Antonín Seam. About 5 - 8 m above the seam roof, it includes a darker layer, called "the Companion" ("průvodce" in Czech), rich in sporomorph content (Konzalová 1977). This complex does not contain plant megafossils. Scanty plant remains can be found only in the upper levels in the typical Cypris Shale According to the local ichthyozones (Obrhelová and Obrhel 1983), the sequence of the Cypris Shale is incomplete in the Sokolov Basin because the uppermost zone with *Gobius* is lacking there.

Methods and material

In the typical Cypris Shale facies, most of the plant magefossils described below are preserved in

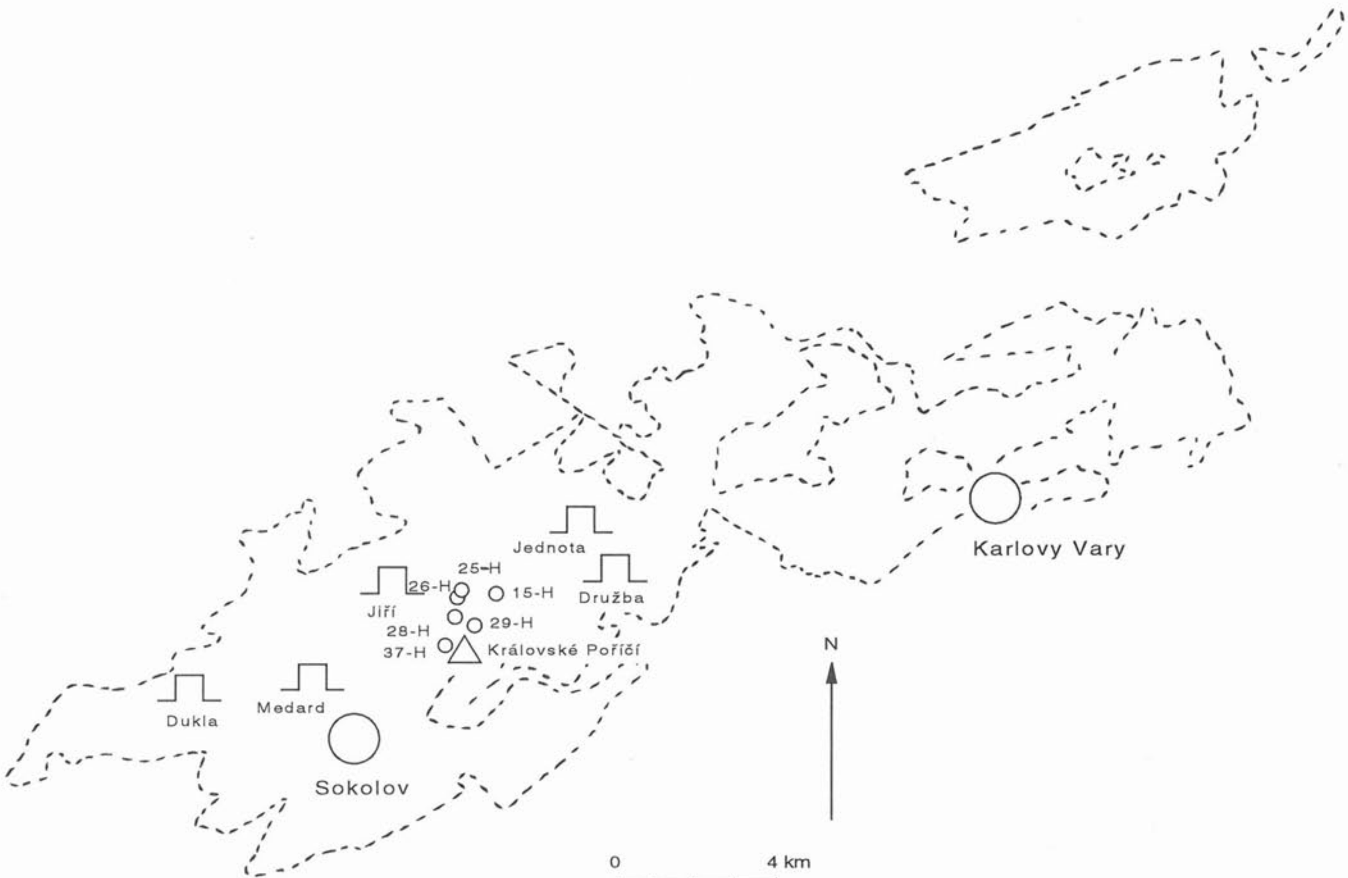

Fig. 3. Collection sites in the Sokolov Basin (circle - core, triangle - outcrop, Dukla, Medard, Jiří, Jednota, Dukla - mines active during the collections).

the form of impressions/compressions with partly preserved cuticles. However, bitumenous content in the claystone prevents easy separation of leaf remains from the matrix and render isolation of cuticles difficult. Preparations are usually not very clean, and usually only obtainable from coriaceous leaves. Rare fruit and seed compressions shrink even after slow dessication of the claystone and lose nearly one quarter of their original size. Coal matter becomes very fragile and cracks easily. To prevent their disintegration, fossils were saturated with an alcohol solution of polyvinylacetate or polyvinylbutyrale.

Psammitic facies was treated by a routine procedure of washing, seaving (with a 0.09 mm net) and picking of disseminules under a lens.

Most of the material at hand stems from new collections made in surface outcrops and in cores as indicated above. At present, most of the described material has been transferred into the Palaeontological Department of the National Museum, Prague. A portion of the original specimens described by Engelhardt (1880) are curated in the National Museum, Prague, having been transferred from the former German Carl-Ferdinand University, Prague. The rest has remained at the Science Faculty, Charles University, Prague and in the Staatliches Museum für Mineralogie und Geologie, Dresden (MMG). A small collection of leaves from the abandoned mine Boží Požehnání at Pochlovice, made by J. Kukalová while searching for fossil insects, as well as by B. Růžička and the staff of the Mining Highschool, Ostrava, in 1955 were located in the Palaeontological Department of the Charles University, Praha (PRC) and added into the manuscript. Excluded from this study was palaeocarpological record from the seam and its equivalents. In addition the mastixioid flora of Františkovy Lázně and plant remains from the sites outside the extent of the Cypris Shale, e.g. the core V 146 near Plesná (Bůžek et al. 1982) will be described elsewhere.

Systematic descriptions

Characeae

"Chara" neogenica ENGELHARDT

1880 *Chara neogenica* nov. sp.; Engelhardt, p. 5, pl. 7, figs 3-5.

Description. Fine plant remains - thin, shortly articulate and obviously smooth thalli with long, linear leaf-like appendages, longer than the internodes, which are usually darker. Any other structures not discernible.

Remarks. Obrhel (1964) and Obrhelová (1966) consider these fossils to be true stonewart remains and, indeed, the structures do resemble thalli of Characeae. However, the poor state of preservation does not allow us to verify Engelhardt's observation. Masses of such remains occurred on bedding planes of the uppermost strata of the section in the Dukla Mine, already removed today.

Occurrence. Cheb Basin - core HV 12, 105-106 m Mokřina; Sokolov Basin - core 29 P, 62-63 m, Dukla and Jiří Mines.

Roselliniaceae

Rosellinites areolatus (FRESENIUS et MEYER) KIRCHHEIMER

1941 *Rosellinites areolatus* (FRESENIUS et MEYER); Kirchheimer, p. 195, text-fig. 2.

Description. The recovered specimens do not differ from those described from the Miocene of the North Bohemian Basin (see Bůžek and Holý 1964).

Remarks. The perithecia of this species are common in the Miocene and Pliocene strata. They match those of the modern genus *Rosellinia* DE NOT., which forms the same subglobular, tightly set perithecia with distinctly tuberculate ostiole. In our case, the perithecia are found detached from the matrix and lie isolated in the claystone.

Occurrence. Cheb Basin - core HV 13, 158-159 m.

Mycophyta gen. et sp. div.

1880 *Sphaeria evanescens* HEER; Engelhardt, p. 5, pl. 7. fig. 1.
1880 *Xylomites cassiae* nov. sp.; Engelhardt, p. 5, pl. 7, fig. 2.

Remarks. Abundant microscopic remains of fungi - spores, stromas and sterile mycelia - have been found in cuticular preparations of carbonized leaves and other organs. In view of laborious identification, hardly reliable in most cases, they are not described in detail. In addition, small lustrous sclerotia have occasionally been found in washings.

Occurrence. Cheb Basin - cores H 13, 25 m, HV 1, 166-167 m, HV 6, 106-107 m, HV 11, 81-82m, HV 17, 56-57 m, Mokřina; Sokolov Basin - Dukla Mine.

Ricciaceae

Riccia cf. *fluitans* L.

Description. Thalli narrowly ribbon-shaped, usually fragmentary, 0.6-1 mm wide, more time forked, without a midrib, quite smooth, without any traces of air chambers. Some thalli peeled off the claystone, but the macerated fragments did not show any strucure except groups of roundish to angular cavities (3-4 μm across), probably due to crystals.

Remarks. Obrhel (1964) described identical sterile thalli from the Cypris Shale. They mainly represent only apical parts of the branched thalli. The lack of rhizoids, air chambers and ventral scales, as well as the obviously vegetative reproduction may attest to a submerged water life form. The modern *Riccia fluitans* can also survive on the mud in a subaerial form. A comparison of the fossils with *Riccia fluitans* relies in fact only on similarity in gross morphology. *Metzgeria* RADDI, which produces similar thalli, differs in the trichomes (see Váša in Svrček et al. 1978).

Occurrence. Cheb Basin - cores HV 1, 109.1 m, HV 3, 124-125 m, HV 10, 54-55 m, HV 11, 86-87 m, HV 14, 169-170 m, cf. HV 18, 74-76 m, V 5, 59-60 m, cf. 60-61 m.

Osmundaceae

Osmunda sp.

Pl. 1, fig. 3

Description. A pinna of oval outline, c. 25 mm long, at its base 10 mm wide, margin damaged, indistinct, midrib straight, quite thick, secondaries thin, forked near the midrib and again about half way or two thirds towards the margin.

Remarks. The pinna differs in size and in the character of the midrib from the fossil remains assigned to *Lygodium gaudinii* HEER (see below) but matches well with the foliage of *Osmunda*.

Occurrence. Cheb Basin - core A 28, 91-92 m.

Schizaeace

Lygodium gaudinii HEER

Pl. 1, figs 1, 5

1855 *Lygodium gaudinii* HEER, p. 41, pl. 13, figs 5-15.

Description. One apical part of the sterile pinna (c. 12 mm wide and 42 mm long) with subparallel margins, nearly entire, midrib wavy zig-zag, dichopodially branched, secondaries steep, 2-3 times forked. One fragmentary fertile pinna with spores in situ of the *Leiotriletes* (NAUM.) R. POT. to *Triplanosporites* PF. emend. TH. et PF. - types.

Remarks. The material was described and discussed in detail by Bůžek and Konzalová (1983).

Occurrence. Cheb Basin - cores HV 8, 112-113 m, HV 6, 108-109 m.

Salviniaceae

Salvinia sp.

Pl. 1, fig. 2

Description. Leaf fragments, in some cases with well preserved reticulate venation, in one specimen with trichomes oriented subparallel to each other, in one case with floats near the leaf base, identical with such organs found in *Salvinia reussii* ETT. in the North Bohemian Basin (see Bůžek, Konzalová and Kvaček 1971).

Remarks. The incomplete remains might not differ from *S. reussii*, with regard to the association with the floats.

Occurrence. Cheb Basin - cores HV 6, 112-113 m, HV 11, 81-82 m, 84-85 m.

Thelypteridaceae

Pronephrium stiriacum (UNGER) KNOBLOCH et KVAČEK

Pl. 1, fig. 4

1847 *Polypodites stiriacus* UNG.; Unger, p. 121, pl. 36, figs 1-5.
1976 *Pronephrium stiriacum* (UNGER) comb. n.; Knobloch et Kvaček, p. 12, pl. 1, fig. 1.

Remarks. A single fragmentary pinna corresponds in venation of pinnules with the material described in detail by Bůžek (1971) from the North Bohemian Basin.

Polypodiaceae gen. et sp. indet.

Remarks. Fragmentary pinnae, sterile, not determinable to the genus level.

Occurrence. Cheb Basin - cores HV 8, 131-132 m, HV 14, 175-176 m.

Pinaceae

Pinus hepios (UNGER) HEER

Pl. 2, fig. 4

1850a *Pinites hepios* UNG.; Unger, p. 362.
1855 *Pinus hepios* UNG. sp.; Heer, p. 57, pl. 21, fig. 7.

Remarks. Mostly fragmentary needle leaves, rarely needles joined in fascicles of two or three have been encountered. Fascicles of two or three needles, described as *Pinus hepios* and *P. taedaeformis* occur together in the localities of the Middle Miocene age such as Weingraben (Berger 1953), Magyaregregy (Pálfalvy 1950) or Abaliget (Pálfalvy 1965). Engelhardt (1880) and Menzel (1901) mentioned only fascicles of three needles as *P. rigios* (UNGER) ETT. from the Cypris Shale, Růžička and Beneš's (1951) record also contains *P. hepios*.

The available material suggests that the species with two needles occurred only in the youngest part of the Cypris Shale, mainly in the southern part of the Cheb Basin (e.g. at Kaceřov). The same type occurs in the Miocene of Plzeň and in South Bohemia, the Mydlovary Formation (Němejc 1968).

Unger (1852) compared his species with the North American *P. mitis* MCHX. (i.e. *P. echinata* MILL.). The needles of this species diverge, are pointed and finely toothed. Menzel (1901) mentioned another Recent analogon, namely *P. halepensis* MILL. from the Mediterranean. Its needles, however, are rather short, only 5-6 cm in length; the related *P. halepensis* var. *brutia* (TENORE) A. HENRY (i.e. *P. brutia* TENORE, P. *paroliniana* WEBB) from southern Italy and the eastern Mediterranean, *P. pithyusa* STRNGW. and *P. eldarica* MEDW. from the Caucasus area and Asia Minor have longer needles (up to 10-15 cm).

Occurrence. Cheb Basin - cores HV 1, 96.2m, HV 3, 56-57 m, HV 7, 40-41 m, 85-86 m, HV 14, 151-152 m, HV 15, 94-95 m, V 5, 60-61 m, A 28, 91-92 m, Kaceřov; Sokolov Basin - cores 25 H, 64-65 m, 29 P, 21-22 m.

Pinus rigios (UNGER) ETTINGSHAUSEN

Pl. 2, fig. 6, pl. 3, fig. 5

1850a *Pinites rigios* UNG.; Unger, p. 362.
1852 *Pinites rigios* UNG.; Unger, p. 25, pl. 13, fig. 3.
1866 *Pinus rigios* UNG. sp.; Ettingshausen, p. 41, pl. 13, figs 11-12, 15.
1880 *Pinus rigios* UNG. sp.; Engelhardt, p. 6, pl. 7, figs 6-7, pl. 9, fig. 1.
1901 *Pinus rigios* UNG. sp.; Menzel, p. 61, pl. 3, figs 1-3, pl. 4, fig. 2.

Description. Needle leaves in fascicles of three, up to 17 cm long and 1.2-2 mm wide (sheath c. 20 mm long), originaly triangular in cross section, secondarily compressed, the proximal edge appearing sometimes as the midrib. Stomata sunken in grooves, in 2-3 separate rows on both sides of the edge. Rows on the outer side of the needles wide apart.

Remarks. This type of pine foliage is quite common in the Cypris Shale (Engelhardt 1880, Menzel 1901, Růžička and Beneš 1951). Unger (1852) compared his species with the Recent *P. rigida* MILL., *P. taeda* L., *P. gerardiana* WALL. Menzel (1901) excluded the latter possibility due to much longer complete leaves, which were found in the fossil state and believed *P. taeda* from the southeastern USA best matched the fossil species in leaf length. However, this Recent species has toothed needles, which is not the case in our material.

Occurrence. Cheb Basin - cores HV 3, 56-57 m, HV 6, 107-109 m, HV 8, 108-109 m, HV 13, 204-205 m, HV 14, 230-231 m, HV 18, 46-47 m, V 1, 33-34 m, V 3a, 42-43 m, 71-72 m, 73-74 m,V 5, 60-61 m, V 14, 63-64 m, D 7, 23.6 m, A 42, 18-19 m, HP 7 P, 43-44 m, HP 14 P, 278 m, Pochlovice, Kaceřov; Sokolov Basin - cores 25 H, 64-65 m, 29 P, 37-38 m, Dukla and Družba Mines, environs of Sokolov.

Pinus cf. *saturni* UNGER

? 1841 *Pinus saturni* UNG.; Unger, p. 16, pls 4-5.

Remarks. Some of the needle leaves are surprisingly thin and joined in fascicles of three. It probably represent the third species different from the above mentioned one. Such remains are known in the literature under a more frequent synonym *P. taedaeformis* (UNGER) ETT. (see Menzel 1901). Menzel (1901) does not mention *P. saturni* from the Cypris Shale, but he records it from the North Bohemian Basin. Some of our specimens seem to have only two needles in the fascicle, and it is possible that these are in fact only thinner needles of the two previous species.

Unger (1841) compares *P. saturni* with the modern Mexican *P. patula* SCHIEDE et DEPPE, but according to Menzel (1901) it can be also compared with other species, e.g. *P. serotina* MCHX., *P. sabineana* DOUGL. from North America and even with *P. canariensis* SMITH. The latter is often mentioned from the Pliocene of southern Europe (see e.g. Kasapligil 1978), its needles are, however, dentate.

Occurrence. Cheb Basin - cores HV 1, 96.2 m, 97.5-97.6, HV 2, 99-100 m, HV 18, 39-40 m, 52-53 m, V 3a, 40-41 m, V 5, 60-61 m, Pochlovice.

Pinus sp. (foliage)

Pl. 3, figs 2-3

Description. Isolated leaf fragments. Some of them yielded poorly preserved epidermal structure. Separate stomatal rows consist of monocyclic, longitudinally aligned stomata with deeply sunken guard cells (c. 40-60 μm in lentgh), surrounded by 2 polar and 4-8 lateral subsidiary cells. Ordinary elongate cells have finely undulate anticlines.

Remarks. Most of fragmentary specimens are not determinable to the species level. Even anatomical characteristics do not allow us to assign the fossils to a particular species (see also Florin 1931, Kilpper 1968a).

Occurrence. Cheb Basin - majority cores studied, Pochlovice, Kaceřov, Mokřina, Kynšperk; Sokolov Basin - cores 25 H, 86-87 m, 37 H, 26-37 m, Dukla, Družba, Jiří Mines.

Pinus sp. div. (male cones)

Pl. 2, fig. 3

1901 *Pinus* - männliche Blüthen; Menzel, p. 60, pl. 3, fig. 14.

Description. Isolated male cones, originally cylindrical, widest in the upper part, with a large number of stamens bearing two pollen sacs along the abaxial side.

Remarks. The cones are found in various stages of maturity, but mostly without traces of pollen grains. In one case the pollen in situ was of the *Haploxylon*-type, otherwise the *Diploxylon*-type prevails. Some of these fossils may even belong to other genera of Pinaceae, but this cannot be determined on the basis of the available characteristics.

Occurrence. Cheb Basin - most of cores studied, Pochlovice, Kaceřov; Sokolov Basin - Dukla Mine.

Pinus sp. div. (seeds)

Pl. 2, figs 2, 5

1880 *Pinus rigios* UNG. sp.; Engelhardt, p. 6, pl. 7, fig. 8.
1880 *Pinus furcata* UNG. sp.; Engelhardt, p. 6, pl. 7, fig. 9.
1880 *Pinus pseudonigra* sp. nov.; Engelhardt, p. 6, pl. 7, fig. 10.
1901 *Pinus laricio* POIR.; Menzel, p. 55, pl. 3, fig. 9.
1901 *Pinus* - Samen; Menzel, p. 59, pl. 2, figs 5-6, 11.

Description. The pine seeds are of two forms. The first one is characterized by a relatively large seed, surrounded by a broad wing. Similar seeds were described e.g. from the locality Schoenneg (Ettingshausen 1890) as *P. taedaeformis* and occur in the modern *P. taeda* L., *P. radiata* D. DON (i.e. *P. insignis* DOUGL.), *P. rigida* MILL. etc. The second type, with smaller seeds and a narrower wing, seems to be more abundant. It may represent, however, a quite unnatural group. Such seeds were described by Ettingshausen (1890) as *P. palaeo-strobus* ETT. and *P. prae-pumila* ETT. Similar seeds are produced by many modern species of pine, but also, for instance, by *Keteleeria*.

Occurrence. Cheb Basin - majority cores studied, Mokřina (coll. Engelhardt); Sokolov Basin - Dukla, Družba, Jiří Mines.

Pinus sp. div. (female cones)

Pl. 2, figs 1, 7

1901 *Pinus laricio* POIR.; Menzel, p. 55, pl. 3, fig. 22.

Description. Female cones of oval form, c. 10 cm long and c. 6 cm wide, apophyses well differentiated, conically arched, integral or slightly wavy, rhomboidal, finely radially striated, with a small distinct low conical umbo and less distinct transversal keel.

Remarks. More complete specimens show apophyses of the type of *P. pinaster* AITON (i.e. *P. maritima* POIRET). Similar, but less arched, flatter apophyses are developed in *P. leucodermis* AITON, *P. halepensis* var. *brutia* (TENORE) A. HENRY, *P. halepensis* MILL. (syn. *P. maritima* LAMBERT), *P. hartwegii* LINDL., *P. radiata* D. DON (syn. *P. insignis* DOUGL.) and *P. laricio* POIR. (i.e. *P. nigra* ARNOLD). Similar cones are produced also by *P. rigida* MILLER, *P. ponderosa* DOUGL. and *P. taeda* L. The latter species differs by its ovally conical and relatively wider form. Most of the fossil cones as well as isolated cone scales are poorly preserved and may even represent different species.

Occurrence. Cheb Basin - HV 4, 70-71 m, HV 8, 88-89 m, 111-112 m, HV 9, 72-73 m, HV 18, 80-81 m, V 1, 87-88 m, V 5, 65-66 m, D 7, 22.6 m, Kaceřov; Sokolov Basin - Dukla and Družba Mines.

cf. *Cathaya roseltii* SCHNEIDER

Pl. 3, fig. 4

? 1981 *Cathaya roseltii* sp. n.; Schneider, p. 889, pl. 1-2, text-figs 1a-e.

Description. A fragmentary, flat, 2 mm wide needle with thinly cutinized epidermis. Leaf hypostomatic, stomata in two bands with c. 8 rows, tightly arranged, longitudinally orientated, probably monocyclic, with sunken guard cells surrounded by 2 polar (mostly shared by two adjoining stomata) and 2 (?) lateral cells, anticlines of ordinary cells smooth, straight.

Remarks. The monocyclic stomata suggest the genera *Pseudotsuga* CARR. or *Cathaya* CHUN et KUANG. Similar remains were described by Zalewska (in Czezcott et al. 1961) from the Early Miocene of Turow as *Podocarpus* sp. 1, or by Litke (1966) from the Lower Lusatia Seam as *Podocarpus* cf. *kinkelinii* MÄDLER. Better preserved material from the same horizon was recognized as remains of *Cathaya* by Schneider (1981). C. *abchasica* SVESHN. (see Kolakovskij and Šakryl 1974) differs from our specimen by its wider needles.

Occurrence. Cheb Basin - core HV 17, 48-49 m.

Taxodiaceae

Glyptostrobus europaeus (BRONGNIART) UNGER

Pl. 1, figs 6-10

1833 *Taxodium europaeum* BRONGNIART, p. 168.
1850b *Glyptostrobus europaeus* BRONGN. sp.; Unger, p. 434.

Description. The morphology of small branches with leaves, cones, cone scales and seeds does not differ from the material from the North Bohemian Basin. The seeds from washings have usually incomplete wings, the impressions on the matrix show the length of wings (4-6 mm), which corresponds approximately with the seed length.

Remarks. Dorofeev (1974) recognized several species on the basis of structure of the testa. He also noted the rare occurrence of this genus in the Middle Miocene of Siberia in contrast to the abundant record from Europe in the same period. In his opinion this tree survived in Europe to the Pleistocene, but so far no evidence is available. The above described remains are mostly confined to the coal clay facies.

Occurrence. Cheb Basin - cores HV 9, 73-74 m, HV 11, 81-82 m, 84-87 m, 90-91 m, 92-93 m, HV 12, 109-110 m, HV 18, 79-80 m, HV 19a, 74-75 m, 77-78 m, V 1, 46-47 m, 54-55 m, 88-89 m, V 2, 76-77 m, V 3a, 69-70 m, 75-76 m, 78-79 m, V 4, 31-32 m, V 5, 64-65 m, V 9, 104-105 m, V 11, 81-82 m, V 14, 63-64 m, D 2, 9.8 m, 13-13.6 m; Sokolov Basin - Medard Mine.

Cupressaceae

Tetraclinis salicornioides (UNGER) KVAČEK

Pl. 1, figs 11-12

1841 *Thuites salicornioides* UNG.; Unger, p. 11, pl. 2, figs 1-4.
1901 *Libocedrus salicornioides* UNG. sp.; Menzel, p. 101.
1989 *Tetraclinis salicornioides* (UNGER) comb. nova; Kvaček, p. 48, pl. 1, fig. 11, pl. 2, figs 2-14, pl. 3, figs 3-4, text-fig. 1.

Descripton. Rare small foliage shoots, more frequently isolated leaf segments with a typical cuticular structure.

Remarks. The remains correspond in morphology and cuticular structure with the material described in detail by Friis (1977) and Kvaček (1989). A cone found attached in the specimen from Flörsheim (Kvaček 1989) corroborates the generic assignement of this typical conifer.

Occurrence. Cheb Basin - cores HV 2, 104.3 m, HV 4, 89-90 m, 100-101 m, HV 5, 59-60 m, HV 8, 129-130 m, HV 9, 115-116 m, HV 11, 84-85 m, HV 14, 221-222 m, HV 15, 96-97 m, HV 19a, 77-78 m.

? *Chamaecyparis* sp.

Pl. 1, fig. 13, pl. 3, fig. 1

Description. A fragmentary leafy shoot, dorsiventrally flattened, alternately branched, scale leaves in decussate pairs, differentiated into marginal and facial leaves. The former up to 4 mm long, joining each other in the lower two thirds of the length, and shorter in higher positions, c. 1.5 mm long. The latter rounded rhombic, c. 1 mm long. Stomata monocyclic, oval stomatal pit c. 30 µm across, bordered by inconspicuous cutin ridge (proximal papillae). Otherwise no papillae seen on the epidermis.

Remarks. This sterile small branch resembles the subfamily Cupressoideae of the northern hemisphere. Similar material was described e.g. by Berger (1957b) as *Thuja saviana* GAUD. from Italian Miocene (Gabbro) or by Łancucka-Środoniowa (1966) from the Badenian of southern Poland. Strikingly similar fragments are illustrated by Szafer (1961) as *Chamaecyparis pisifera* SIEB. et ZUCC. from the Middle Miocene of Stare Gliwice. Without attached cones such material is difficult to assign to a genus.

Occurrence. Cheb Basin - core HV 3, 120-121 m.

Magnoliaceae

Magnolia burseracea (MENZEL) MAI

Pl. 4, figs 1-15

1913 *Carpolithes burseraceus* MENZEL; Menzel, p. 84-86, pl. 7, figs 10-12.
1975 *Magnolia burseracea* (MENZEL) comb. n.; Mai, p. 567, pl. 35, figs 24-33.

Description. Seed outline elongate and oval to obcordate, sometimes slightly asymmetrical, evidently longer than wider, 7-12 mm long, 5-8 mm wide and widest in the lower third or middle, in the area of the chalaza widely rounded and sometimes distinctly concave (mainly on the dorsal side), rarely with an indistinct colar. The heteropyle developed, but mostly indistinct, c. 0.6 mm wide. A small rest of the "stalk" has been observed only in few cases. The porus of medium size, more probably roundish or oval, terminal. The raphe sinus discernible in some specimens only, the trace of the raphe seen usually in imprint material. Seeds distally (to the micropyle) narrower than to the area of the chalaza, but the micropylar end blunt, rounded, the micropyle itself has never been observed. Seed surface more or less smooth, the wall of the testa c. 0.45 (to 0.57) mm thick.

Remarks. The seeds correspond with the type of *Magnolia sinuata* KIRCHH. sensu Mai (1964), who transferred it later (Mai 1975) to *M. burseraceae*. Among the material studied sleder specimens also occur, which recall *M. boveyana* CHANDLER, or some larger and rather wider forms similar to those of *M. lignita* (UNGER) MAI. The dimensions of our material are on average larger than those given by Mai (1975) because the imprints, which are c. 1-2 mm longer than the carbonized seed compressions, have been incorporated in the measurement. Our imperfect material can hardly help solve the problem of whether or not all three above mentioned species are conspecific (see Gregor 1975a, 1978a). The above described seeds are undoubtedly identical with those described from the Hrádek area of the Zittau Basin as *M. burseracea* (Holý 1977a) and may belong to the leaves of *M. kristinae* KNOBLOCH et KVAČEK, which often occur together. A modern analogon has not been so far recovered (Mai 1975).

Occurrence. Cheb Basin - cores HV 1, 136.4 m, 140.6 m, HV 2, 93.8 m, 105.5 m, 111-112 m, HV 3, 91-92 m, HV 4, 68.5 m, HV 5, 59-60 m, HV 6, 112-113 m, HV 8, 142-144 m, HV 9, 82-83 m, HV 12, 62-63 m, 106 m, HV 13, 137-138 m, 209-210 m, HV 14, 142-143 m, (?) 228-229 m, V 3a, 72-73 m, Mokřina (coll. Engelhardt); Sokolov Basin - Dukla and Jiří Mines, Medard Mine (erosion filling in the Antonín Seam).

Magnolia kristinae KNOBLOCH et KVAČEK

Pl. 6, figs 1-2, pl. 9, fig. 10

1976 *Magnolia kristinae* sp. nov.; Knobloch and Kvaček, p. 18, pl. 4, figs 5, 7, 13, 15-19, pl. 5, figs 1-7, pl. 15, fig. 14, text-fig. 5.

Description. Leaves mostly fragmentary, lanceolate to oval, entire-margined, shortly petiolate, 15-22 mm wide and 60 or more mm long, with a rounded to widely cuneate base (leaf apex not preserved). Venation brochidodrome, secondaries thin, at wide angles to the midrib, steeper at the base, looping well within the margin. Frequent intersecondaries terminate in the loops. Tertiary veins at a right angle to the midrib, higher order venation forming meshes parallel with the secondaries. Adaxial epidermis usually hairless, medium cutinized, anticlines of the ordinary cells wavy to U-shaped undulate. Abaxial epidermis of one specimen thickly hairy, with slightly wavy anticlines of ordinary cells, in other specimens disintegrating in fragments with solitary hair bases and strongly undulate anticlines. Trichome bases serial, rounded, composed of a rounded cell wedged between the ordinary cells and a part of the thin terminal cell. Stomata paracytic with wide straight-walled subsidiary cells and with a pair of guard cells c. 16-20 µm long, with an almost invisible outline of peripheral walls.

Remarks. This species, typical of younger mastixioid floras of Central Europe, is described in detail in a separate paper (Kvaček 1979). It resembles some subtropical representatives of the genus *Magnolia* L. from southeastern Asia.

Occurrence. Cheb Basin - cores HV 1, 113-114 m, 129.9 m, 131.5 m, 138.6 m, HV 2, 112.8 m, HV 4, 61-62 m, HV 6, 92-93 m, HV 8, 118-119 m, HV 11, 59-60 m, Pochlovice.

Nymphaeaceae

Nymphaea szaferi KNOBLOCH

Pl. 4, fig. 16

1978 *Nymphaea szaferi* sp. nov.; Knobloch, p. 155, pl. 2, figs 1-4, 7.

Description. A flattened seed of oval ovate outline, 2.2 mm long and 1.5 mm wide, narrowed equally towards the base and the apex. Base rounded, apex obtuse, seed wall very thin, probably uni-layered, cells transversally oblong-rectangular in outline, arranged in c. 14 longitudinal rows on either side, with wavy anticlinal walls. Fine strips of fine trichomes seen among the rows.

Remarks. Similar seeds were described by Łancucka-Środoniowa (1957) from the Miocene of Rypin as *Nymphaea alba L.* foss., which correspond in the form and outline of epidermal cells with our material. Szafer (1961) recognized two species in the Sarmatian of Stare Gliwice: *N. alba* L. foss. resembles our species in size, only it is rather robust, *N. lotus* is smaller, but matches well with our specimen in the number of rows of epidermal cells and in the form of cells.

Other fossil species are different. *N. ovaliisperma* DOROFEEV (in Dorofeev et al. 1974) from the Lower (?), Middle and Upper Miocene of western and eastern Siberia is similar in size, but its epidermal cells are shortly rectangular and the walls are slightly wavy. *N. longisperma* DOROFEEV (l. c.) from the Miocene of western Siberia is distinctly longer, with 12-15 cell rows and on one half of the surface. Another species *N. borystenica* DOROFEEV (l. c.) from the Pliocene of Belarus and Russia is larger and has epidermal cells of different shape. *N. pussila* DOROFEEV (l. c.) from the Pliocen of Belarus is one third smaller, having a rounded oval to pear-like outline, with epidermal cells roundish quadrangular. *N.* cf. *coerula* SAV. from the Moldavian Upper Miocene (Negru 1972) differs by its considerably smaller size and rectangularly barrel-shaped outline, and by only 13 rows of cells on each side of the seed. *N. szaferi* KNOBLOCH described from the Lower Miocene of southern Moravia differs only in its widely elliptical to roundish outline. As the figure in Knobloch (1978, pl. 2) shows, the seeds were very flattened by compression (this fact is not mentioned by the author) and therefore they appear more plump. The figures also confirm that at least 15-16 rows of cells occur on one side of the seed while Knobloch (l. c.) refers to 10-16.

Occurrence. Cheb Basin - core V 14, 22-23 m.

Nymphaeaceae gen. et sp. indet.

Pl. 4, fig. 17

Description. A secondarily completely flattened and much deformed seed rounded in outline, 3.7 mm wide. Germinal aperture not discernible. The surface covered with a very fine reticulum of polygonal cells 0.04-0.05 mm across, with straight walls.

Remarks. More precise determination is impossible due to the poor preservation. The size and cell structure of the seed's testa resembles the genus *Nuphar* SMITH.

Occurrence. Cheb Basin - core HV 12, 106 m.

Schisandraceae

Schisandra sp.

Pl. 27, figs 3-6

Description. Seeds reniform or obliquely reniform, usually primarily more or less compressed, one seed end flatter, the other more arched, the hilum transverse, somewhat obliquely situated, length 2.25-3.5 mm, height 1.66-2.3 mm. Micropylar end usually more twisted above the hilar scar and its upper part formed by a rounded edge. Hilar scar long and deep, very compressed between both ends of the campylotropous curved seed. Micropyle directed in the hilar pit and situated on a neck-like papillate protuberance. C. 0.075 mm-0.1 mm thick wall formed externally of more or less isodiametric sclerenchymatous cells (radial sclereids), which reach the surface as fine dots. Very tiny dotted pits pass towards the narrower end on the seed into parallel grooves. Sclerotesta covered by a very thin epidermis, which shows fine parallel grooves. The inner part of testa finely membranous, lightly brown.

Remarks. Mai, who described similar seeds from the Moravian Miocene as a new species *Kadsura moravica* MAI (in Knobloch 1978), brought our attention to the possible generic affinity of our material. The Moravian specimens match well with those described above in size but differ in a more regularly reniform form, the hilar scar is not oblique and compressed, but symmetrically open, deep and 0.8-1.05 mm wide. These differences might fall within the variability of seeds of the same species. All such remains have been newly referred to as *Schisandra* of the same family (Gregor 1981, 1982).

Occurrence. Cheb Basin - core HV 14, 217-218 m, Pochlovice; Sokolov Basin - Medard Mine (erosion filling in the Antonín Seam).

Cercidiphyllaceae

Cercidiphyllum crenatum (UNGER) R. BROWN

Pl. 5, fig. 14

1850a *Dombeyopsis crenata* UNG.; Unger, p. 448.
1935 *Cercidiphyllum crenatum* (UNG.) R. BROWN; Brown, p. 575, pl. 68, figs 1, 6, 8-10.

Description. Three follicles of the fruit on a shared short stalk. The follicles with a surface areolation orientated longitudinally (discernible only in a small part of the impression without coal matter).

Remarks. Similar, but rather larger fruit remains were described from the Polish Silesia by Kräusel (1920) as *Widdringtonia helvetica* HEER. Also *Widdringtonia bohemica* ETTINGSHAUSEN (1866) from Jenišův Újezd might be of the same nature. The Tertiary European record was summarized by Jähnichen et al. (1980).

Occurrence. Cheb Basin - core HV 14, 221-222 m.

Myricaceae

Myrica lignitum (UNGER) SAPORTA

Pl. 5, figs 1-3, 11-12, pl. 6, figs 3-4, 6

1847 *Quercus lignitum* UNG.; Unger, p. 113, pl. 31, figs 5-7.
1865 *Myrica lignitum* UNG. sp.; Saporta, p. 102.
1880 *Myrica lignitum* UNG. sp.; Engelhardt, p. 7, pro parte, pl. 7, fig. 16.
1880 *Lambertia tertiaria* nov. sp.; Engelhardt, p. 11, pl. 7, fig. 28.
1880 *Dryandroides concinua* HEER; Engelhardt, p. 11, pl. 7, fig. 30.
1880 *Dryandroides undulata* HEER; Engelhardt, p. 11, pl. 7, fig. 30.

Description. Leaves elongate, slender, 3.5-7 cm long and c. 1 cm wide in the middle, to the base gradually and to the apex more abruptly narrower, entire-margined to coarsely dentate except the apex and the base (additional small teeth may appear in the basal and apical parts, they occasionally descend lower on one side than on the other one). The midrib strong, secondaries eucamptodrome to craspedodrome, thin, at angles of 45°-80°, in dentate leaves forked at the margin, one branch entering the tooth, the other the sinus, where it ends at the leaf margin. Intersecondaries irregularly branched, forming a fine polygonal network with the higher-order venation. Texture evidently firm. Due to thin cutinization only small fragments of cuticles have been obtained, showing poor cell structure: anticlines of rather small polygonal cells straight, thin, biseriate bases of peltate hairs dispersed, rarely with the polycellular, rounded shield preserved, slightly cutinized stomata 12-15 μm long, with a short, widely oval outer cavity.

Remarks. The character of venation and cuticular structure correspond with the standard form, described e.g. from Wackersdorf (Knobloch and Kvaček 1976) or from the type locality Parschlug (Kovar 1982). In our material the entire-margined form prevails. *M. lignitum* differs from another common Neogene species *M. integerrima* KRÄUSEL et WEYLAND by smaller stomata and thinner cutinization.

Occurrence. Cheb Basin - cores HV 1, 129.8 m, 140-141 m, HV 2, 81.3 m, 111-112 m, (?) 127 m, HV 4, (?) 106.3 m, HV 6, 107-108 m, (?) 119-120 m, HV 10, (?) 58-59 m, HV 11, (?) 81-82 m, 87.8 m, (?) 88-89 m, HV 13, (?) 129-140 m, HV 14, 140-141 m, HV 15, (?) depth unknown, V3a, (?) 75-76 m, 78-79 m, V 5, (?) 64-65 m, V 7, 80-82 m, Kaceřov, Mokřina (coll. Engelhardt).

Myrica vindobonensis (ETTINGSHAUSEN) HEER

Pl. 5, fig. 4

1851 *Dryandra vindobonensis* ETTINGSH.; Ettingshausen, p. 18, pl. 3, fig. 6.
1856 *Myrica (Comptonia) vindobonensis*; Heer, p. 34, pl. 70, figs 5-6.

Remarks. Very similar, if not identical leaves were also described as *M. oehningensis* (A. BR.) HEER (1856, 1859) or *Comptonia oehningensis* A. BR. (Hantke 1954).

Occurrence. Sokolov Basin - Dukla Mine.

Myrica cf. *minima* NEGRU

Pl. 5, fig. 13

? 1957 *Myrica sp.*; Łancucka-Środoniowa, p. 20-21, pl. 3, figs 10-14.
? 1961 *Myrica suppanii* KIRCHHEIMER; Szafer, p. 33-34, pl. 9, fig. 8.
? 1972 *Myrica minima* sp. nov.; Negru, p. 84, pl. 10, figs 1-10, text-fig. 18.

Description. Fruits of widely oval and rounded outline, usually secondarily deformed. Length (1.5-) 2.2-2.5 (-2.8) mm, width 1.2-2.3 (-2.6) mm. Apex and base rounded. Locule very shallow, widely oval. The wall in the level of dehiscence is the thinnest on the sides above the base, and widest (0.17-0.23 mm) on the sides in the upper third. The thickest wall is in the middle of the fruit valve on the front side. Complete specimens are usually compressed more or less obliquely to the plane of dehiscence or perpendicular to it. Exocarp verrucose, papillae globular to oval, 0.13-

0.2 mm large, thickly clustered next to each other. Endocarp almost smooth to slightly rugose (traces of exocarp papillae).

Remarks. Negru (1972) described very similar fruits from the Moldavian Sarmatian, which, however, are not so thickened on the front sides of the exocarp. This is due to the compression perpendicular to the dehiscence plane (contrary to our material). The material, which is stated as synonymous, from the Polish Miocene, is undoubtedly conspecific. The endocarps from Rypin (Łancucka-Środoniowa 1957) have, however, the locules of a more obcordate outline. The fruits described by Knobloch (1978) as *M. ceriferiformoides* BŮŽEK et HOLÝ from the Moravian Miocene belong to the same group.

Fruits of *Myrica* are abundant in the taphocenoses of coal-forming vegetation, particularly in the younger Tertiary deposits of Europe. In spite of a considerable diversity of forms, the record of various species is quite confusing (see Gregor 1975a) due to emendations not based on the original or topotypical material (Mai 1964) or subjective interpretations of the original diagnoses. The evaluation of the fossil record of *Myrica* would be possible in a comprehensive monograph.

A very similar modern species, *M. cerifera* L., is a psammophilous element from river banks in the SE U.S.A. and West Indian Islands.

Occurrence. Cheb Basin - cores HV 1, 141 m, HV 2, 106.3 m, HV 11, 90-91 m.

Comptonia acutiloba BRONGNIART

Pl. 5, figs 5-6

1828 *Comptonia acutiloba* BRONGNIART, pp. 141, 143, 209.

Remarks. The leaves, mostly fragmentary, are confind to the lignite clay facies, in which endocarps of the same genus were also recovered. Morphologically they generally match the record from the North Bohemian Basin, however, sometimes the leaf lobes are relatively narrower and longer. The epidermal structure is not preserved.

Occurrence. Cheb Basin - cores HV 11, 88-93 m, HV 19a, 78-79 m, V 3a, 75-76.5 m, D 7, 23.5-24.3 m, A 28, 91-92 m, A 42, 18-19 m.

Comptonia srodoniowae FRIIS

Pl. 5, figs 9-10

1979 *Comptonia srodoniowae* sp. n.; Friis, p. 124, text-figs 6 A-L.

Description. Endocarps (1.8-) 2.8-3.3 (-4.0) mm long, (0.8-) 1.2-1.6 (-2.0) mm wide, often secondarily slightly flattened. In the outline usually widely or narrowly spindle-shaped, also longitudinally drop-shaped, oblong to obovate. Apex longitudinally narrowed (in spindle-shaped or drop-shaped forms) to elongate into a style, sometimes slightly curved, 0.1-0.4 mm long. Base cuneate or abruptly narrowed in a sharp stalk, rarely blunt to rounded. Both valves with 1-6 (-8) more or less distinct ribs, rarely smooth. Ribs mostly short, beginning usually above the base and ending above the middle of the endocarp or valve. Quite exceptionally some ribs pass through. They are mostly low, partly more distinct. Fruits bisymmetrical, two-valved, rarely three-valved. The suture of the plane of dehiscence is situated in the keeled edge, which starts in the lower third and ends at the style. In some specimens, remains of coriaceous exocarp are preserved. Locule almost always of oblong drop-shaped outline.

Remarks. The endocarps at hand do not differ from the species described by Friis (1979) from the Danish Middle Miocene. However, this author does not mention either the exocarp or the keel in the dehiscence suture, though both features are visible in some photographs. *C. longistyla* (NIKITIN) DOROFEEV (1966) from the Oligocene and Miocene of Siberia is very similar and differs from our material mainly by a larger number of very long ribs and by the absence of the keeled edge on the outer dehiscence suture.

Occurrence. Cheb Basin - cores D 2, 13-13.5 m, D 10, 20.4 m, V 10, 98-98.2 m, V 12, 90.8-91 m; core H 13, 25 m.

Comptonia cf. *srodoniowae* FRIIS

Pl. 5, figs 7-8

? 1979 *Comptonia srodoniowae* sp. n.; Friis, p. 124, text-figs 6 A-L.

Description. Fruits flat biconvex, spindle-shaped to longly ovate spindle-shaped. Length 2.2-3.3 mm, width 1.0-1.3 mm. Base longly narrowed in a blunt stalk, 0.3 mm long, apex elongate, narrowed into the style, 0.3-0.4 mm long. Exocarp medium coriaceous, tightly adhering to the endocarp, very finely longitudinally wrinkled, built up of tiny parenchyme cells. Endocarp mostly smooth, sometimes with a short fine rib running from the base of the style to the upper fourth, or two thirds up the fruit length. In one specimen, each side contains one pair of arched ribs running from the keel ledge on the dehiscence suture arch-like towards the apex.

Remarks. The fruits differ from the typical forms of *C. srodoniowae* by their smooth endocarps, the presence of coriaceous exocarp and by a slender shape but do resemble some specimens illustrated by Friis (1979, figs 6 C, L). They represent most probably unripe fruits of the same species.

Occurrence. Cheb Basin - cores D 2, 9.6-9.8 m, 12.8-13.5 m, V 1, depth unknown.

Juglandaceae

cf. *Pterocarya* sp.

Remarks. One incomplete and rather poorly preserved leaf corresponds best with the foliage of this genus by the character of the margin. The secondaries, however, are rather straight. The specimen may also represent an untypical leaf of *Alnus gaudinii*.

Occurrence. Sokolov Basin - Dukla Mine.

Cyclocarya nucifera (LUDWIG) MAI

Pl. 8, figs 7-8

1857 *Zizyphus nuciferus* m.; Ludwig, p. 102, pl. 20., fig. 23.
1964 *Cyclocarya nucifera* (LUDWIG) comb. n.; Mai, p. 20, pl. 3, figs 3-5.

Description. Bivalved fruit, secondarily compressed, of round, disk-like form, c. 3.5 mm across. Apex short conically tapering. Surface smooth, without ridges or protuberances. The inner side of the nut valve forms two rounded cavities separated by a column of the primary septum, secondary septa not ascertained.

Remarks. The record is specifically identical with the type of the species (Ludwig 1857, Mai 1973) from the Lower Villafranchian of Wetterau. Similar specimens are known from the European Miocene and Pliocene (see Mai and Walther 1988).

Occurrence. Cheb Basin - core HV 8, 131-132 m.

Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER

Pl. 6, fig. 5, pl. 7, figs 1-5

1856 *Banksia orsbergensis* m.; Wessel and Weber, p. 146, pl. 25, fig. 9a.
1880 *Myrica lignitum* UNG. sp.; Engelhardt, p. 7, pro parte, pl. 7, fig. 15.
1880 *Banksia longifolia* ETT.; Engelhardt, p. 10, pl. 7, figs 24-25.
1880 *Dryandroides serotina* HEER; Engelhardt, p. 11, pl. 7, fig. 29.
1880 *Rhus coriacea* nov. sp.; Engelhardt, p. 15, pl. 8, fig. 18.
1977 *Engelhardtia orsbergensis* (WESSEL et WEBER) comb. nov.; Jähnichen, Mai and Walther, p. 329, pl. 43, figs 1-3, pl. 44, figs 1-3.

Description. Leaflets morphologically identical with those described by Jähnichen et al. (1977) and others, exceptionally with preserved cuticles. Adaxial epidermis is composed of lobate cells with omega-shaped undulate anticlines. Abaxial epidermis shows usually typical simple bases of peltate trichomes and stomata surrounded by papillate cells. In rare cases papillae are not developed and the stomata have a well discernible widely spindle-like outer cavity. These leaves bear only rare trichome bases.

Remarks. These leaves/leaflets were correctly recognized as belonging to *Engelhardia* for the first time by Saporta (1865) and from Bohemia by Engelhardt (1898). These remains have been treated alternatively as belonging to the section *Palaeocarya* (SAPORTA) KNOBLOCH et KVAČEK, a fossil genus *Palaeocarya* SAPORTA or a formal genus *Oreoroa* DILCHER et MANCHESTER (see Manchester 1987a) and we prefer the former status. Although complete leaves are mostly paripinnate, some of the specimens suggest that the midrib is preserved in the direct line with the rhachis and hence such specimens may be imparipinnate (Jähnichen et al. 1977, pl. 38, fig. 1, pl. 43, fig. 4.). These authors and also Kvaček (1972) noted that some specimens show stomatal periphery without papillae - a trait of the sect. *Engelhardia*. It may be a natural variation, or aberrant specimens rather than another, independent species.

In the Cypris Shale of both basins, *E. orsbergensis* is a common species. Leaflets may vary in form from considerably long and narrow to relatively short and wide. The former are usually sparsely toothed. It is not clear, if these extreme forms existed next each other on the same tree or even leaf, or if they represent different ecotypes due to edafical conditions or microclimate.

Occurrence. Cheb Basin - most cores studied, Kaceřov, Pochlovice; Sokolov Basin - Dukla Mine.

Engelhardia macroptera (BRONGNIART) UNGER

Pl. 7, figs 6-9

1828 *Carpinus macroptera* BRONGNIART, p. 48, pl.3, fig. 6.
1866 *Engelhardtia macroptera* BRONGN. sp.; Unger, p. 52, pl. 16, figs 9-11.
1880 *Engelhardtia Brongniartii* SAP.; Engelhardt, p. 16, pl. 8, fig. 20.

Description. The material corresponds completely with the specimens described by Jähnichen et al. (1977). Sometimes a reduced adaxial bractea is present, which covers the nut. Peltate trichomes are observable sporadically in some specimens and are very dispersed on the involucra but thickly covering the nuts. At the base of side lobes, distinct auriculae are rarely developed. At the apex of the nuts, two poorly preserved, c. 1.25 mm long filaments are sometimes preserved (which may correspond to perigonal tepals ?) and in some cases other 1-2 shorter or longer formations (corresponding perhaps to the style, or other perigonal elements ?). The inner structure of the nut is poorly discernible due to strong compression and can be estimated from the convex or concave outline of the "kernel" (seed), and only rarely from the direct sight of its interior.

Remarks. In the modern *E. roxburghiana* LINDL. ex WALL. (sect. *Psilocarpae*), transferred recently into an independet genus *Alfaropsis* ILJINSKAJA (1993), the involucrum forms a basal border ("cupule") on the adaxial side around the nut . Such feature has not been observed in our material. In *E. spicata* LESCH. ex BL. (sect. *Engelhardia*) the abaxial involucrum often fuses at the base with the adaxial bractea, which is distinctly bilobed and connected on the sides with the side lobes of the involucrum. Sometimes it forms only small lobes ("auriculae") at the base of the side lobes. These occur only rarely in the fossil record (Mai in Jähnichen et al. 1977, text-figs 9/26, 27).

The nature of organs at the apex of nuts is not quite clear. They may represent remains of the perigon, which is composed of 4 persistent tepals in *Engelhardia*, but may not be all preserved in the fossils (see also Dilcher et al. 1976). If some inner elements represent remains of the style, then this would be rather short, like in sect. *Psilocarpae* and in *Oreomunnea*, while sect. *Engelhardia* possesses long styles in comparison with the tepals.

The dimensions of nuts vary considerably, like at other sites (see Mai l.c.). Both specimens from Kučlín illustrated by Mai are relatively large, and double in size in comparison with the smallest specimen from Reichswalde. The original dimensions of nuts are close to the size of the impressions left in the matrix while the carbonized compression may show smaller sizes due the contraction during dessication.

According to Mai (l. c.) the inner structure of nuts is related especially to that of *E. roxburgiana* (sect. *Psilocarpae*), i.e. to *Alfaropsis*. In most cases, our material is very compressed. In one specimen the inner structure was uncovered by further preparation, and indeed, it better corresponds to the sect. *Psilocarpae*, but certainly not with *Oreomunnea*. It is noteworthy that the associated pollen is often referred to as the *wallichiana*-type, i.e. matches with the pollen of *E. roxburgiana* (syn. *E. wallichiana* LINDL., *E. chrysolepis* HANCE) (Konzalová 1976, pers. communication).

It is evident that *E. macroptera* is a very old type connected with evolutionary lineages to all sections and *Oreomunnea*. Manchester (1987a) proposed a more or less artificial emendation of *Palaeocarya* SAPORTA to accommodate all similar fossil fruits. This procedure has been rejected by Iljinskaja (1993), who prefers to recognize *Palaeocarya* and *Alfaropsis* in addition to *Engelhardia*.

Occurrence. Cheb Basin - cores HV 1, 141 m, 141.5 m, 145-146 m, HV 2, 117.2 m, 117.5 m, HV 3, 89-90 m, 90.3 m, 98-99 m, 107-108 m, 118-119 m, HV 4, 81-82 m, 90-92 m, 103-104 m, HV 5, 61-62 m, HV 6, 99-100 m, 104-105 m, 108-109 m, HV 8, 127-129 m, 131-132 m, 138-139 m, HV 9, 84-85 m, 92-93 m, 96-97 m, HV 10, 60-61 m, HV 11, 56 m, 61-62 m, 89-90 m, HV 12, 84-85 m, 88-89 m, 97-98 m, HV 13, 137-138 m, 165-166 m, HV 14, 158-159 m, 213-214 m, 224-225 m, 227-228 m, HV 15, 82-83 m, HV 18, 36-37 m, V 3a, 70-71 m, D 7, 24.2 m, Kaceřov; Sokolov Basin - core 25 H, 126-127 m, Dukla Mine, Jednota Mine.

Carya sp.

Pl. 8, figs 1-4, 6

Description. A leaflet falcate, margin conspicuously irregularly dentate, teeth rather short, more blunt. Venation semicraspedodrome, secondaries at a right angle (in the lower part of the leaflet) or almost so (further upwards), forked at the margin into two branches, the lower entering the tooth and the upper one arch-like connecting with the following secondary vein. Side veins from the arches enter the teeth. Tertiaries obliquely transversal to orthogonal, higher-order venation forms a very distinct and fine orthogonal network. Petiolule rather long, suggesting, contrary to falcate form, a terminal position of the leaflet. Texture probably fine. Two more leaflets of similar morphology but less distinct venation.

Remarks. The affinity to *Carya* is unequivocal. The teeth and marginal venation of our specimens resemble *C. serrifolia* (GOEPP.) KRÄUSEL.

Occurrence. Cheb Basin - cores HV 10, 63-64 m, ? V 12, 45.8 m, ? H 3, 143.5 m.

Betulaceae

Betula sp. (foliage)

Pl. 9, figs 1-3

Description. Leaves ovate, the widest in the lower third, slightly asymmetrical at the base, secondaries few, margin distinctly double dentate, venation craspedodrome.

Remarks. The morphological character of leaves is clearly betuloid. The modern hybrids *B. divaricata* LEDEB. or *B. zabelii* SCHELLE have similar leaves. Our material is too scanty to allow more reliable comparisons.

Occurrence. Cheb Basin - core HV 9, 112-113 m; Sokolov Basin - Dukla Mine.

Betula sp. (fruits)

Pl. 9, figs 4-5

Description. Samaras obovate to spindle-like, 2.05-2.67 mm long, 1.25-1.5 mm wide, the widest in the middle or in the upper third. Base rounded or truncate, apex suddenly narrowed in two-armed projections correspopnding to up to 2.5 mm long style with arched arms. Slightly membraneous wings on each side without structure, very wide, almost twice as wide as the nut, more than semicircular in outline, reaching very low under the fruit base. In some poorly preserved specimens the wings appear smaller and are not situated so low.

Remarks. *B. longisquamosa* MÄDLER (1939, pl. 6, fig. 21) from the Pliocene near Frankfurt/M. matches well with our material in size and shape. Also similar is *B. uralensis* DOROFEEV (1970) from the Lower Miocene of Ural, but it differs by a finely emarginate base. Two additional similar species were described from the Siberian Miocene: *B. samylinae* DOROFEEV (1969) and *B. lenensis* DOROFEEV (1969). However, the samaras of the former species are conspicuously asymmetrical, bent and thick-walled, those of the latter more robust and also thick-walled. They do not show such strikingly long styles as our specimens.

Of the modern species, *B. mandschurica* (REGEL) NAKAI and *B. ermanii* CHAM. from East Asia have fruits with similar large wings.

Occurrence. Cheb Basin - cores HV 3, 124-125 m, HV 8, 119-120 m, HV 12, 109 m, Mokřina (coll.Engelhardt); Sokolov Basin - Dukla Mine.

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK

Pl. 9, fig. 7, pl. 10, figs 2-4, pl. 14, fig. 4

1856 *Rhamnus gaudinii* m.; Heer, p. 79, pl. 124, figs 4-15, pl. 125, figs 1, 7, 13.

? 1880 *Rhamnus gaudinii* HEER; Engelhardt, p. 15. pl. 7, fig. 1.

1976 *Alnus gaudinii* (HEER) comb. nova; Knobloch and Kvaček, p. 33, pl. 6, figs 1, 3, pl. 7, figs 1, 5, pl. 13, fig. 4, pl. 15, figs 1-4, 7-8, 10-11, 13, 15, 17, pl. 16, figs 1-5, pl. 19, fig. 15, pl. 20, fig. 10, text-figs 11-12.

Description. Leaves corresponding exactly with the material from Wackersdorf (Knobloch and Kvaček 1976). Although fragmentarily preserved, epidermal features are identical - abaxial epidermis composed of rather small polygonal cells and variously sized stomata with long spindle-like outer cavity. 4-5-celled gland bases occur rarely, mostly on veinlets branching.

Remarks. In the Cypris Shale, as in Wackersdorf, wider leaves occur beside typical forms and may be considered as extreme variations of the same species. According to Knobloch and Kvaček (l. c.) the modern analogon is probably *A. nitida* (SPACH) ENDL.

Occurrence. Cheb Basin - cores HV 3, 126.8-127 m, HV 13, 128.7 m, HV 11, 81-82 m, V 7, 80-82 m, ? Mokřina; Sokolov Basin - Dukla Mine.

Alnus cf. *julianiformis* (STERNBERG) KVAČEK et HOLÝ

Pl. 9, fig. 8

? 1823 *Phyllites julianaeformis* STERNBERG, pp. 37, 39, pl. 36, fig. 2.

? 1974 *Alnus julianaeformis* (STERNBERG) comb. n.; Kvaček and Holý, p. 368, pls 1-3, pl. 4, fig. 1.

Remarks. Some other oval, poorly preserved leaves closely resemble *A. julianiformis* from the North Bohemian Basin by the character of marginal venation and teeth. A precise identification is nearly impossible.

Occurrence. Cheb Basin - cores HV 11, (?) 85-86 m, V 5, 60-61 m, 64-65 m, V 7, 80-82 m.

Alnus sp. (infructescences)

Pl. 9, fig. 9

Remarks. Rare and poorly preserved female infructescences are not identifiable to the species level.

Occurrence. Cheb Basin - cores HV 11, 90-91 m, HV 18, 56-57 m.

Fagaceae

Quercus kubinyii (KOVATS ex ETTINGSHAUSEN) CZECZOTT

Pl. 11, figs 1, 5-6, pl. 12, fig. 4

1851 *Castanea kubinyii* KOVATS; Ettingshausen, p. 6, pl. 1, fig. 12.

1951 *Quercus kubinyi* (KOVATS) CZ.; Czeczott, p. 392.

Description. Leaves morphologically similar to slender forms described by Knobloch and Kvaček (1976) as *Castanea kubinyii* from Wackersdorf. Our material yielded structure of the abaxial epidermis, which shows oval stomata, c. 18 µm long, with short linear pore, ordinary cells small, straight-walled, bases of glandular serial trichomes rather frequent.

Remarks. Our material corresponds well with the record from Wackersdorf as well as that from Fasterholt (Christensen 1976, sub *Castanea atavia* UNG.). The affinity of the leaves to *Quercus* is inferred from the association with acorns (at Wackersdorf) rather than from the morphology and anatomy of leaves.

Occurrence. Cheb Basin - cores HV 1, 151-152 m, HV 4, 96.4 m, 70-72 m, HV 6, 103-104 m, 105-106 m, 109-110 m, HV 7, 83-84 m, HV 9, 89-90 m, HV 10, 55-56 m, 58-59 m, HV 11, 55-56 m, 59-60 m, 64-65 m, (?) 85-86 m, HV 12, (?) 78-79 m, HV 13, 196-197 m, HV 14, 158-159 m, 172-173 m.

Quercus rhenana (KRÄUSEL et WEYLAND) KNOBLOCH et KVAČEK

Pl. 12, figs 1-3

1950 *Illicium rhenanum* sp. n.; Kräusel and Weyland, p. 50, pl. 9, figs 5-7, pl. 10, figs 1-2, pl. 11, fig. 6, text-fig. 14.

1966 *Quercus lusatica* sp. n.; Jähnichen, p. 447, pl. 1, figs 1-3, pl. 2, figs 4-6, pl. 3, figs 7-8, pl. 4, figs 9-10, pl. 8, figs 16-20, pl. 9, figs 21-22, text-figs 1, 3-4.

1976 *Quercus rhenana* (KRÄUSEL et WEYLAND 1950) comb. nova; Knobloch and Kvaček, p. 41, pl. 17, figs 6, 8, 14, pl. 21, figs 5-6, pl. 24, fig. 10.

Description. A fragmentary middle part of an elongate, entire-margined, c. 20 mm wide leaf. Epidermal structure with typical widely oval stomata bordered by a thickened granular (wax ?) ring seen on the abaxial cuticle. Hair bases of two types occur among them, one rounded, without thickened neighbouring cells, probably belonging to simple glandular trichomes, the other, more abundant, star-like, polygonal, surrounded by a ring of 5-7 small but thickly cutinized cells. The latter belong to stellate hairs, which occasionaly remained preserved.

Remarks. The single specimen occurs in dark coal clay facies. For affinities and distribution see Jähnichen (1966) and Knobloch and Kvaček (1976).

Occurrence. Cheb Basin - core V 3a, 78-79 m.

Quercus cf. *drymeja* UNGER

Pl. 11, figs 2, 4

? 1845 *Quercus drymeja* UNG.; UNGER, p. 113, pl. 32, figs 1-4.

Description. Leaves elongate, with up to 10 mm long petioles, leaf blade 4-5 cm long and 1.5-2 cm wide, with maximal width approximately in the middle or lower part, base rounded to cuneate, base entire-margined, upwards slightly to distinctly dentate, teeth only opposite secondaries, S-shaped, elongate, usually apressed or bent, fine. Venation craspedodrome, midrib very thick, secondaries thinner, sparse, rather straight to slightly bent, intersecondaries in the lower part of the blade, tertiaries orthogonal, slightly wavy, higher-order venation forming fine network. Leaf margins perhaps thickened, otherwise the texture quite thin to slightly firm.

Remarks. The leaves are undoubtedly of quercoidal type, differing from *Quercus kubinyii* particularly in the teeth form (in *Q. kubinyii* longly tapering, mucronate or sharp, extending from the blade, in *Q.* cf. *drymeja* blunt, apressed, partly S-shaped).

Berger (1953) and Knobloch and Kvaček (1982) illustrate leaves of similar character from Weingraben and Tamsweg respectively, and compare them with *Quercus drymeja*. The leaf of cf. *Q. drymeja* from Türkenschanzen (Berger and Zabusch 1953) is also similar. In a later paper Berger (1955, text-figs 9-12) mentioned very similar and probably identical leaves from the localities Schönweg, Hasenchflüchter, and Siegelsdorf under the name *Q. drymeja*, but it is not clear if the wider forms of leaves from the last mentioned locality identified as *Q. mediterranea* UNG. belong to the same species. Morphologically similar specimens were also described from Teiritzberg (Berger 1957a, text-fig. 2), Schrotzburg (Hantke 1954, especially pl. 2, fig. 10, sub *Q. mediterranea*) and Oder 2a (Knobloch and Kvaček 1976, sub *Quercus* sp.). New revision of the flora of the Mydlovary Formation, South Bohemia, (Knobloch and Kvaček, in press) provided evidence of the same species at this site, as suggested by Němejc (1968).

Our leaves, however, do not correspond well with the type material of *Q. drymeja* and *Q. mediterranea* from Parschlug. Only a longer leaf of the latter species (Unger 1845, pl. 32, fig. 5) has similarly appressed teeth. Our specimens have fewer secondaries with maximum widths in the lower third or in the middle, not in the upper part.

A precise modern analogon has not been found. Similar foliage is produced by *Q. serrata* THUNB., described also from the Pleistocene of Japan (Suzuki and Nakagawa 1971), growing today as a small tree on coastal plains, terraces, slopes and low hills in Japan.

Occurrence. Cheb Basin - cores HV 5, 41-42 m, 64-65 m, HV 6, 105-106 m, HV 7, 92-93 m.

Trigonobalanopsis rhamnoides (ROSSMÄSSLER) KVAČEK et WALTHER

Pl. 12, figs 5-6

1840 *Phyllites rhamnoides* m.; Rossmässler, p. 35, pl. 8, figs 30-31.
1880 *Myrica lignitum* UNG. sp.; Engelhardt, p. 7, pro parte, pl. 7, fig. 14.
1880 *Sapindus falcifolius* AL. BRAUN; Engelhardt, p. 14, pro parte, pl. 8, fig. 13.
1880 *Cassia berenices* UNG.; Engelhardt, p. 17, pro parte, pl. 8, figs 23-24.
1880 *Cassia fischeri* HEER; Engelhardt, p. 17, pl. 7, fig. 2, pl. 9, fig. 1c.
1880 *Cassia phaseolites* UNG.; Engelhardt, p. 17, pro parte, pl. 9, fig. 4.
1880 *Leguminosites celastroides* HEER; Engelhardt, p. 18, pl. 9, fig. 8.
1880 *Phyllites diospyroides* HEER; Engelhardt, p. 19, pl. 9, fig. 11.
1988 *Trigonobalanopsis rhamnoides* (ROSSMÄSSLER) KVAČEK et WALTHER; Kvaček and Walther, p. 405, pl. 49, figs 1-8, pls 50-54, pl. 55, figs 2-7, pl. 56, figs 1-4, pl. 57, text-figs 2-4.

Description. Oval entire-margined leaves with regular rhamnoid camptodrome venation and epidermal structure as described by Kvaček and Walther (1988).

Remarks. See Kvaček and Walther (1988).

Occurrence. Cheb Basin - cores HV 1, 107-108 m, 136-136.2 m, 146.6 m, HV 2, 104.7 m, 110.6 m, 112.3 m, 115-116 m, 130.9 m, HV 3, 115-116 m, 118-120 m, 126-127 m, HV 4, 82-83 m, 95-96 m, 96.7 m, 100-101 m, HV 5, 49-50 m, HV 6, 106-108 m, HV 7, 87-89 m, HV 9, 64-65 m, 82-83 m, 108-109 m, HV 11, 54-55 m, 140-141 m, HV 14, 104-105 m, 225-226 m, 227-228 m, HV 18, 51-52 m, HV 19a, 74-75 m, V 3a, 75-76.5 m, Pochlovice, Kaceřov, Mokřina; Sokolov Basin - Dukla Mine, Jehličná, Královské Poříčí (coll. Engelhardt).

Trigonobalanopsis exacantha (MAI) KVAČEK et WALTHER

Pl. 11, fig. 3

1970 *Trigonobalanus exacantha* sp. n.; Mai, pp. 384-387, pl. 1, figs 19-26, pl. 2, figs 1-20 (? non 21-22), pl. 3, figs 1-6, 14-19.
1988 *Trigonobalanopsis exacantha* (MAI) KVAČEK et WALTHER; Kvaček and Walther, p. 404, pls 47-48, pl. 49, fig. 9, pl. 55, fig. 1.

Description. Cupules ovate, closed, asymmetric, on short stalks, in one case two cupules joined (dichasially ?).

Remarks. See Kvaček and Walther (1988).

Occurrence. Cheb Basin - cores HV 4, 81-82 m, HV 8, 142-144 m, HV 14, 151-152 m, 220-221 m, V 14, 21-22 m.

Hamamelidaceae

Distylium fergusonii KNOBLOCH et KVAČEK

Pl. 13, figs 1-2, pl. 14, figs 1-3

? 1880 *Cassia phaseolites* HEER; Engelhardt, p. 17, pl. 9, fig. 5.
1975 *Juglandaceae* (?); Juchniewicz, p. 71, pl. 3, figs 1-3.

1976 *Distylium fergusonii* sp. n.; Knobloch and Kvaček, p. 45, pl. 17, figs 1, 3, 20, pl. 20, figs 1, 7, 13-14, pl. 22, figs 3-8, text-fig. 18.

Description. Leaves oval, entire-margined, at the base asymmetrical, cuneate, 20 × 45 (and greater) mm in size. Convex side of the base facing the branch. Venation brochidodrome, secondaries irregular in course and spacing, partly with intersecondaries. Cuticles of medium thickness. Adaxial epidermis with undulating anticlines, only rarely slightly wrinkled. Massive star-like trichome bases surrounded by up to two circles of smaller straight-walled cells, sparse. Abaxial epidermis usually strongly striated, the course of anticlines hardly discernible, undulate (as in the adaxial leaf side). Stomata paracytic, guard cell pair rounded to oval with a conspicuously widely spindel-like outer cavity, surrounded by two large parallel subsidiary cells. Anticlinal wall between guard and subsidiary cells indistinct. Trichome bases of the same type as in the adaxial side dispersed over the entire leaf surface.

Remarks. The recovered fragmentary branch with two leaves is so far the most complete specimen of this rather rare species. Juchniewicz (1975) erroneously interpreted the stomatal structure and hence also the systematic position of these remains. The paracytic type of stomata is not well visible in poorly preserved specimens. The combination of the stomatal type and trichome bases suggest an affinity with Hamamelidaceae (Ferguson 1971, Knobloch and Kvaček 1976). One of the recovered leaf remains differs by its smaller stomata.

This species is presently known from the later phases of the Early Miocene to the Middle Miocene (Hrádek n. N., Turów, Wackersdorf, Kreuzau, Cheb Basin).

Occurrence. Cheb Basin - cores HV 1, 97.2 m, 170-171 m, HV 14, 171-172 m, ? Mokřina.

Altingiaceae

Liquidambar europaea A. BRAUN

Pl. 13, figs 4-5

1836 *Liquidambar europaea* A. BRAUN; Buckland, p. 513.

Remarks. One small trilobate leaf and one fragment with the lobe number uncertain show undoubtedly characters of *Liquidambar* L. - palmate venation and fine glandular teeth on margins.

Occurrence. Cheb Basin - core HV 9, 105-106 m, Pochlovice.

cf. *Liquidambar* sp.

Pl. 13, fig. 3

Remarks. Very poorly preserved infructescence remains, not comparable either with cones of *Alnus* GAERTN. or with heads of *Platanus* L. At least in one specimen, the ovary seems to be clearly dimeric.

Occurrence. Cheb Basin - cores HV 1, (?) 137.1 m, HV 2, (?) 101 m, 115-116 m, HV 9, (?) 76-77 m, V 5, (?) 35-36 m, V 10, 62-63 m.

Platanaceae

Platanus neptuni (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK

Pl. 10, fig. 5, pl. 14, figs 5-6

1866 *Sparganium neptuni* ETTINGSH.; Ettingshausen, p. 31, pl. 7, figs 10-15 (non 9, 17, 18).
1880 *Sparganium* sp.; Engelhardt, p. 18, pro parte (non pl. 9, fig. 9).
1967 *Platanus neptuni* (ETTINGSHAUSEN 1866) comb. nov.; Bůžek, Holý and Kvaček, p. 205, pls 1-4.

Description. The recovered simple, bluntly dentate leaves and head-like infructescences were described in a separate paper (Bůžek et al. 1967).

Remarks. The material matches in all respects the record from the Bohemian Tertiary and elsewhere.

Occurrence. Cheb Basin - HV 1, 159-160 m, 166-167 m, HV 2, 127 m, 129.4 m, HV 3, 115-116 m, 122-123 m, HV 4, 81-82 m, 90-91 m, 96.8 m, HV 5, 64-65 m, HV 6, 104-105 m, HV 7, 92-93 m, HV 9, 112-113 m, HV 11, 81-83 m, HV 13, 183-184 m, HV 14, 216-217 m, 129-221 m, Pochlovice; Sokolov Basin, core 29 P, 61.2 m, Dukla Mine, environs of Sokolov (coll. Engelhardt).

Ulmaceae

Ulmus sp.

Pl. 15, figs 7-9

Description. Fruits with a peripheral wing, in the distal part near the style cut widely, with the perigone a little shifted down the peduncle under the fruit base.

Remarks. The identical type of fruit is also known from the North Bohemian Basin (Bůžek 1971).

Occurrence. Cheb Basin - cores HV 2, 106.5 m, 127.5 m, HV 8, 141.2 m, HV 11, 86-87 m; Sokolov Basin - Dukla and Družba Mines.

Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA

Pl. 15, figs 1-3, 5

1843 *Ulmus zelkovaefolia* UNG.; Unger, pro parte, pl. 24, figs 7, 9-13, pl. 26, fig. 7.
1847 *Ulmus zelkovaefolia* UNG.; Unger, p. 94.
1880 *Planera ungeri* KOV. sp.; Engelhardt, p. 9, pl. 7, figs 20, 32.
1963 *Zelkova zelkovaefolia* (UNG.) BŮŽEK et KOTLABA; Kotlaba, p. 59, pl. 3, figs 7-8.

Description. Leaves of the same type as described from the North Bohemian Basin (Bůžek 1971), but not so common, partly with finer dentation.

Remarks. While in Asia *Zelkova* has been reliably recorded since the Oligocene, in Europe it was common mainly in the Miocene. Its Oligocene occurrences must be in many cases verified, particularly in view of the lack of fertile remains in this period. Our specimen of a fertile branch gives reliable evidence of the affinity with *Zelkova*. Such branches have been known in Europe since the Ottnangian (Berger 1953).

The epitheton was corrected in terms of the Code by Žilin (1967).

Occurrence. Cheb Basin - cores HV 3, 115-116 m, HV 4, 69-70 m, 100-101 m, HV 8, 126-127 m, HV 10, 66-67 m, 67.6 m, HV 11, 87-88 m, HV 12, 110-111 m, HV 18, 48-49 m, Pochlovice (coll. Engelhardt); Sokolov Basin - core 29 P, 79-80 m, Dukla Mine.

Celtis cf. *lacunosa* (REUSS) KIRCHHEIMER

? 1861 *Pyrenella lacunosa* REUSS; Reuss, pp. 83-84, pl.13, fig. 19.
? 1957 *Celtis lacunosa* (REUSS) KIRCHHEIMER; Kirchheimer, p. 128, pl. 28, figs 121a-c.

Description. The fruit remains agree with the description of the material from Ořechov (Knobloch 1969).

Remarks. The fragments of endocarps of this genus were recovered during the excavations of the foundations for a school building in Františkovy Lázně in 1958 (Fejfar, Pacltová and Žert 1959) and in cores and test pits organized by Fejfar at Dolnice in 1960 and 1966. Their surface structure matches the mentioned species. They are confined to the coaly and variegated facies of the Cypris Shale.

Occurrence. Cheb Basin - Františkovy Lázně, Dolnice.

Cedrelospermum leptospermum (ETTINGSHAUSEN) MANCHESTER

Pl. 15, fig. 6

1853 *Embothrites leptospermos* ETT.; Ettingshausen, p. 51, pl. 14, figs 15-25.
1987b *Cedrelospermum leptospermum* (ETTINGSHAUSEN) comb. nov.; Manchester, p. 122, pl. 1, figs 1-4, pl. 2, fig. 11.

Description. A winged fruit, the seed (proximal) part oblique ovate, 5 mm long, the wing 9 mm long and 4 mm wide, with a distinct incision on the dorsal side. Venation of the wing well visible.

Remarks. Such fruits, usually referred to as *Embothrites borealis* UNG., occur in warm periods of the European Eocene to Miocene. The affinities have recently been clarified by Manchester (1987b, 1989).

Occurrence. Sokolov Basin - Dukla Mine.

Lauraceae

Ocotea hradekensis (KVAČEK et BŮŽEK) KVAČEK comb. n.

Pl. 16, figs 1-2, pl. 18, fig. 3

1966 *Laurophyllum hradekense* sp. n.; Kvaček and Bůžek, p. 292, pl. 2, figs 2-3, pl. 4, figs 5-6 (basionym).

Description. Leaves longly oval to elongate, rarely narrower, cuneate at the base, with a short, thick petiole, up to 35 × 100 mm in size. In some wider specimens, the first (or second) pair of secondaries is more prominent. These secondaries are almost opposite and may contain in the axiles thickenings corresponding to glands. Texture coriaceous. Adaxial epidermis with straight or bent and pitted anticlines. Abaxial epidermis with solitary simple hair bases and characteristic paracytic stomata : stomatal ledges rather broad, not reaching the stomatal poles, subsidiary cells stainless, conspicuous, giving the stomatal apparatus a broadly oval to rhomboidal outline. The length of guard cell pairs (20-) 23-27 (-30) µm.

Remarks. The combination of anatomical features, especially of the stomatal type, and axillar glands (found also in the holotype from Hrádek n. N.) allow us to assign this species directly to *Ocotea* AUBL. (incl. *Nectandra* ROLAND). It is obviously connected with the Tertiary relic *O. foetens* (AIT.) BAILL. of the Canary Islands by numerous of Pliocene and Pleistocene records (as *O. heerii* (GAUD.) MAI). The cuticular characteristics of the latter species is so far lacking. Newer occurrences of *O. hradekensis* from the Early Pannonian of Romania (Givulescu 1973, 1975a, sub *Laurophyllum rhomboidale* and *Ocotea* sp.) support this theory. The leaves are often associated by the fruits of the *Ocotea*-type, e.g. in Wackersdorf, Hrádek n. N.

Occurrence. Cheb Basin - cores HV 1, 130.5 m, HV 2, 133.5 m, HV 3, 105-106 m, HV 4, 81-82 m, HV 5, 62-63 m, HV 11, 88-90 m, HV 16, 37-38 m, V 1, 46-47 m, V 9, 64-65 m.

cf. *Sassafras* sp.

Pl. 16, fig. 5, pl. 17, fig. 8, pl. 19, fig. 3

Description. A trilobate leaf with the middle lobe the longest and widest, lobes half as long as the leaf, entire-margined. Venation brochidodrome-reticulodrome. Basal veins of the equal thickness starting at one point on the blade base, the lateral ones at 45° and acropetally bent. Secondaries in the main lobe very fine, rather close to each other, at an angle of 60° and greater with the midrib. Tertiary and higher-order veins form a thick reticulum of small meshes.

Another fragmentary apex of a much larger leaf with well preserved epidermis structure, showing a thin midrib and secondaries at an angle of 60° looping at the entire margin. Adaxial epidermis formed of small polygonal cells (c. 15 µm across) with fine and shallow undulate anticlines and solitary stomata at the margin. Abaxial epidermis thinly cutinized, granular, hairless, ordinary cells domed, anticlines hardly discernible, slightly wavy. Stomata paracytic, rounded to oval, 12-18 µm long. Lens-shaped oil cells in the mesophyll abundant.

Remarks. The lobed leaves of the genus *Sassafras* cannot be easily discriminated from those of *Lindera* THUNB. (*L. triloba* BLUME), and simple leaves are morphologically hardly distinguishable within the Lauraceae. Imchanickaja (1967) stresses the value of epidermal structure in determination of fossil leaves of *Sassafras* TREY. Our first specimen, in contrast to *Sassafras*, has a different position of the primaries, which diverge from the very base of the leaf. The other sample of a fragmentary leaf conforms well with the genus in epidermal structure. Straus (1930) described a similar structure from the leaf, referred to as *S. variifolium* NIL. from the Pliocene of Willershausen and Imchanickaja (1967) suggested it might be related to the modern *S. tzumu* (HEMSLEY) HEMSLEY. Our fragment also shares some common features, such as domed cells, with this modern species. But both Straus's and our specimen differ from modern species by their much smaller stomata. Ferguson (1971) described simple lauroid leaves as taxa XXIV and XXV from Kreuzau, which bear domed cells and paracytic stomata very similar to our material. He was able to find similarities with the genera *Machilus, Litsea, Neolitsea* and *Lindera*.

Occurrence. Cheb Basin - cores HV 8, 135-136 m, V 7, 74-75 m.

Laurus abchasica (KOLAKOVSKIJ et SHAKRYL) FERGUSON

Pl. 17, fig. 1, pl. 19, figs 1-2

1958 *Laurophyllum abchasicum* KOLAK. et SHAKR.; Kolakovskij and Šakryl, 346, pl. 7, figs 1-3, pl. 10, figs 4-8.

1974 *Laurus abchasica* (KOLAKOVSKIJ et SHAKRYL) comb. nov.; Ferguson, P. 64, text-figs 7 A-H, 8 A-D, 9 A-D, 10.

Description. The larger of the two recovered fragments is an oval leaf of the original size c. 30 × 75 mm, and another, complete, widely oval specimen is much smaller, 29 × 35 mm in size. A strong and fine undulation of anticlines, adaxially stronger, with Ω-shaped loops, and a specifical rhomboidal shape of paracytic stomata is characteristic of both. Trichome bases occur sparsely only on the midrib of the abaxial leaf side.

Remarks. The fruits of *Laurus* L. have not been recovered in the Tertiary deposits. However, the characteristic epidermal structure allows one to recognize this genus even in small fragments. *L. abchasica* differs from the two modern representatives of the genus by smaller stomata and may be a common ancestor of both (Ferguson 1974).

Occurrence. Cheb Basin - cores HV 1, 97.4 m, HV 9, 100-101 m, Pochlovice.

Laurophyllum markvarticense KVAČEK

Pl. 17, fig. 4, pl. 19, fig. 6

1971 *Laurophyllum markvarticense* sp. n.; Kvaček, p. 52, pl. 1, fig. 7, pl. 6, figs 1-3, textfig. 2.

Description. Two smaller leaves, c. 20 mm wide and one abnormally large and complete specimen, 60 × 160 mm, matching in oval shape, entire margin and cuneate base. Brochidodrome venation without prominent basal veins and widely spaced, slightly bent secondaries. Texture coriaceous. Adaxial epidermis with epidermal secretory oil cells, appearing as stainless thin spots c. 35-50 μm across. Paracytic stomata roundish-quadrangular, 16-20 (-25) μm long. Anticlines straight or bent.

Remarks. This characteristic species has newly been described from the Middle - Upper Miocene of Romania (Givulescu 1968, sub *Laurophyllum bournense*, Givulescu 1975b, 1992, sub *L. liviae, L. gracile, L. album* and *Laurophyllites trilineatus*). Also *L. nobile* KOLAKOVSKIJ et SHAKRYL (in Kolakovskij 1958) is quite similar but does not show secretory epidermal cells. Affinities to the modern Lauraceae are so far not clear.

Occurrence. Cheb Basin - cores HV 1, 166-167 m, HV 3, 112-113 m, Pochlovice; Sokolov Basin, Dukla Mine.

Laurophyllum medimontanum BŮŽEK, HOLÝ et KVAČEK

Pl. 17, fig. 7, pl. 18, figs 5-6

1976 *Laurophyllum medimontanum* sp. n.; Bůžek, Holý and Kvaček, p. 98, pl. 9, figs 1-5, pl. 16, figs 1-6, pl. 17, fig. 1-2.

Description. An incomplete entire-margined leaf with a slender base and pinnate brochidodrome venation. Incomplete width 15 mm, length 23 mm. Adaxial epidermis medium cutinized with anticlines straight or slightly wavy. Abaxial epidermis very thinly cutinized, characteristic of the species: cells doomed, appearing as rounded outlines bordered by wrinkled lines, partly double, partly disappearing, instead of distinct anticlines. Inconspicuous rounded trichome bases dispersed among ordinary cells. Inconspicuous rounded stomata (12-20 µm in length), showing spindle-shaped outer cavities, wedged between ordinary cells.

Remarks. The above described unique specimen proves the existence of this species till the Miocene, even though it was considered as an index form of the floras of the Volcanic Complexes (Knobloch et al. 1975). Its epidermal structure resembles that of *L. saxonicum* LITKE.

Occurrence. Cheb Basin - core HV 2, 81.9 m.

Laurophyllum nechranicense BŮŽEK et KVAČEK

Pl. 17, fig. 5, pl. 18, figs 1-2

1957 *Diospyros lotoides* UNG.; Raniecka-Bobrovska p. 280, pl. 2, figs 22-24, text-fig. 6.
1966 Lauraceae sp. 1; Litke, p. 367, pl. 20, figs 4-5, text-fig. 6.
1974 *Laurophyllum nechranicense* sp. n.; Bůžek and Kvaček, p. 10, pl. 2, figs 1-4, text-figs 1-3.

Description. Leaves lanceolate to oval, c. 12-38 mm wide and 50-80 mm (and more) long, entire-margined, at the base narrow cuneate, longly petiolate. Texture firm. Adaxial epidermis with straight to slightly wavy to coarsely undulate (in large specimens) anticlines, in the latter case with bead-like thickenings. Adaxial epidermis with always wavy or undulate anticlines. Paracytic stomata oval to transversally oval, 17-22 µm long, in better preserved specimens with a distinct, light outline between guard and subsidiary cells. Inconspicuous stomatal ledges run along the pore demarcating narrow, spindle-shaped outer cavity. Trichome bases variable in density. Hypodermal tissue rarely preserved. Abundant lense-shaped oil cells in mesophyll.

Remarks. The epidermal structure of this species recalls that of *Daphnogene polymorpha* (A. BR.) ETT., which differs by a very short pore and thin stomatal ledges. The recovered specimens are differentiated into narrow xeromorphic and large mesomorphic forms by the course of adaxial anticlines and density of pubescence.

Relations to the modern Lauraceae remain unknown.

Occurrence. Cheb Basin - cores HV 3, 108-109 m, HV 4, 77-78 m, HV 7, 87-88 m, HV 8, 112-113 m, HV 9, 98-99 m, HV 10, 58-60 m, HV 11, 55-56 m, 62-63 m, 65-66 m, HV 12, 85-86 m, HV 14, 199-200 m, 227-228 m, HV 16, 56-57 m, HV 18, 49-50 m, V 3a, 69-70 m, V 5, 52-53 m, V 7, 80-82 m, V 10, 78-79 m, H 2, 70-71 m, Pochlovice; Sokolov Basin - Dukla Mine.

Laurophyllum pseudoprinceps WEYLAND et KILPPER

Pl. 17, fig. 3, pl. 19, fig. 4

1963 *Laurophyllum pseudoprinceps* WEYL. et KILPP.; Weyland and Kilpper, p. 100, pl. 23, figs 14-19, text-fig. 6.

Description. Leaves longly lanceolate to ovate-lanceolate, entire-margined, petiolate, apex often elongate (drip-tip) 7-40 × 15-85 mm in size, venation pinnate, brochidodrome, the lower pair of secondaries sometimes more prominent. Texture coriaceous. Adaxial epidermis with straight to strongly undulate anticlines, mostly covered with bead-like thickenings. Adaxial epidermis with wavy to undulate anticlines, rarely almost straight, mostly pitted. Paracytic stomata rather uniform in form and size, the guard cells (ledges) often granular (? wax). The range of stomatal length varies between specimens, the majority 18-22 µm, in 6 % of the samples between 15 and 18 µm, in few specimens 22-25 µm. Lens-shaped oil cells preserved in most cases.

Remarks. This species, undoubtedly most common in the European late Tertiary, shows considerable variation in epidermal struture and the extreme forms have been treated by previous authors as independent species. Kvaček (1971) and Ferguson (1971) expressed doubts about these units and found transitions between them. Rare cases of specimens with larger stomata (the *macrostoma* - type) may correspond to polyploide cytotypes within the species. In comparison with the populations in Wiesa or Hrádek n. N., our material is less variable in epidermal structure. This may suggest mesophytic conditions with less variable microclimates.

The form of the stomata in *L. pseudoprinceps* is very similar to that of *Ocotea*. This species is often associated with the fruits of this genus.

Occurrence. Cheb Basin - majority of cores studied, Pochlovice; Sokolov Basin, Dukla, Družba and Jiří Mines.

Laurophyllum rugatum KVAČEK et BŮŽEK

Pl. 16, figs 3-4, pl. 18, fig. 4

1966 *Laurophyllum rugatum* sp. n.; Kvaček and Bůžek, p. 292, pl. 1, figs 3-5, pl. 4, fig. 4.

Description. Leaves elongate, longly cuneate, 8-18 mm wide, and 10-100 (and greater) mm long, entire-margined. Petiole up to 12 mm long. Venation brochidodrome, secondaries rather steep (30°- 45°), without intersecondaries. Texture coriaceous. Adaxial epidermis mostly straight-walled, rarely with wavy anticlines, nearly hairless, partly with striation, parallel with veins. Abaxial epidermis thinner, densely hairy, stomata paracytic, rhomboidal in shape. Hair bases 12-13 μm across. Lens-shaped oil cells often preserved.

Remarks. This species has been reliably recorded only from the Miocene. It differs from a similar Eocene *L. lanatum* RÜFFLE (in Rüffle et al. 1976) by its rhomboidal shape of stomata and more crowded hair bases. Sun forms of *L. nechranicense* also resemble this species, but have smaller and less frequent hair bases.

The relation of *L. rugatum* to the modern Lauraceae has so far not been elucidated.

Occurrence. Cheb Basin - cores HV 1, 117.8 m, HV 2, 112-112.3 m, HV 3, 87-88 m, V 3a, 69-70 m, V 14, 77-79 m.

Laurophyllum sp.

Pl. 16, figs 6-7, pl. 17, fig. 6

Description. Leaves with poorly preserved cuticles or only impressions of various size, mostly ovate to elongate, entire-margined, venation brochidodrome, without prominent basal secondaries, often with lens-shape oil cells in mesophyll.

Remarks. These lauroid leaves without distinctly preserved abaxial epidermis structure or mere impressions may belong to some of the above described species.

Occurrence. Cheb Basin - majority of cores studied, Pochlovice, Kaceřov; Sokolov Basin - majority of cores studied, Dukla and Jiří Mines.

Daphnogene polymorpha (A. BRAUN) ETTINGSHAUSEN

Pl. 16, fig. 8, pl. 17, fig. 2, pl. 19, fig. 5

1845 *Ceanothus polymorphus* A. BR.; Braun, p. 171.
1851 *Daphnogene polymorpha* ETTINGSH.; Ettingshausen, p. 16, pl. 2, figs 23-25.
1880 *Cinnamomum scheuchzeri* HEER; Engelhardt, p. 9, pl. 7, fig. 21.
1880 *Cinnamomum lanceolatum* UNG. sp.; Engelhardt, p. 10, pl. 7, figs 22-23.

Description. Rather rich material of triveined, entire-margined cinnamomoid leaves reveals morphological variation: slender lanceolate to oval forms prevail over rare wide and large (up to 40 × 90 mm) specimens. Epidermal structure varies in anticlines of adaxial epidermis from straight (in most cases) to finely wavy or undulate, sometimes with tiny bead-like thickenings. Also in the abaxial epidermis, the course of anticlines varies in a similar way. Hair bases may be nearly absent to very dense (mostly in narrower forms). Some leaves with less distinct basal secondaries (the *Daphnogene ungeri*-type) differ in extremely thinly cutinized abaxial epidermis and are almost hairless.

Remarks. The recovered specimens correspond in variation and the prevailing *scheuchzeri*-form with other Miocene populations (Kvaček and Walther 1974).

Occurrence. Cheb Basin - most cores studied, Pochlovice, Kaceřov, Kynšperk, Mokřina; Sokolov Basin, cores 25 H, 45-46 m, 26 H, 37-38 m, 29 P, 12-13 m, 28-29 m,40-41 m, Dukla Mine, Jehličná.

Laurocarpum sp. div.

Description. One fruit probably subglobular, now completely compressed, splitted into pieces. Another fruit enclosed by more than two thirds into the cupule, with an apical tip.

Remarks. The first of the specimens is indeterminable. It resembles *Persea* P. MILL. and *Phoebe* NEES (incl. *Apollonias* NEES), but the fruits of these genera bear persistent calyx. The second specimen may belong to *Ocotea* AUBL., but the cupule reaches rather high on the fruit.

Occurrence. Cheb Basin - core HV 12, 59-60 m; Sokolov Basin - Dukla Mine.

Droseraceae

Aldrovanda intermedia E. M. REID et CHANDLER

Pl. 4, fig. 18

1926 *Aldrovanda intermedia* sp. n.; Reid and Chandler, p. 113, pl. 6, figs 27-29.

Description. Seeds widely oval, 1.3 mm long and 0.9-1 mm wide. Apex rounded, with a conical, 0.15 long protrusion of chalaza, slightly diverging from the seed axis. Base rounded, with a widely conical, truncate neck, 0.1 mm high, 0.3 mm wide in the aperture. The groove (or keel) of raphe not observed. The testa lustrous to duly lustrous, very finely dotted by cell structure. Sclerotesta c. 0.06 mm thick.

Remarks. The specimens' shape and size match smaller seeds of this species. In length they are closer to Nikitin's species *A. eleanorae* NIKITIN (Upper Miocene of western Siberia, Pliocene of the European part of Russia), which differs by a roundish or very slender shape, less distinct protrusion and a shorter hillar neck.

A. intermedia occurs from the latest Eocene (Bembridge Marl) till Upper Miocene (Don area), in western Siberia from Oligocene to Miocene.

Aldrovanda thrives in stagnant fresh waters of the warm and warm-temperate belt (southern Europe, central and eastern Asia, India, Japan, northern Australia, central and eastern Africa). The waters are usually acidic, humic, with peaty bottoms. It also inhabits shallow and eutrophic ponds, where it occurs in the zone between floating aquatic plants and swampy banks.

Occurrence. Sokolov Basin - Jiří Mine (erosion filling in the Antonín Seam).

Rosaceae

Prunus sp.

Pl. 10, fig. 1

Description. Endocarp quite large, primarily slightly compressed, evidently with a rather thick wall (according to the remaining coal matter), with a hard, prickly protuberance at the apex. Surface generally smooth.

Remarks. The endocarp, due to its asymmetry and other features, most likely belongs to the subfamily Prunoideae.

Occurrence. Sokolov Basin - Dukla Mine.

cf. ***Prunus*** sp.

Pl. 8, fig. 5

Remarks. The character of the margin suggests a prunoid leaf. Glands on teeth were not observed, and venation is indistinct due to carbonized matter. No cuticule remains preserved.

Occurrence. Cheb Basin - core HV 11, 86-87 m.

Fabaceae

Podocarpium podocarpum (A. BRAUN) HERENDEEN

Pl. 20, figs 9-15

1825 *Cabomba oeningensis* KOENIG; König, pl. 15, fig. 181 (nom. nudum)
1836 *Gleditschia podocarpa* A. BR.; Buckland, p. 513.
1851 *Podocarpium knorrii* A. BR.; Stitzenberger, p. 90.
1859 *Podogonium knorri* HEER; Heer, p. 114, pl. 134, figs 22-26a, pl. 135 (non fig. 9), pl. 136, figs 1-9.
1880 *Podogonium knorrii* HEER; Engelhardt, p. 18, pl. 8, figs 25-26
1957 *Podogonium oeningense* (KOENIG) KIRCHHEIMER; Kirchheimer, p. 261. pl. 1, fig. 1, pl. 20, figs 90. a-b.
1992b *Podocarpium podocarpum* (A. BRAUN) HERENDEEN, comb. nov.; Herendeen, p. 732.

Description. Leaflets of obviously coriaceous texture, corresponding morphologically with the material described by Bůžek (1971). The epidermal tissue is thinly cutinized, the carbonized remains are mostly fragmented. Only small fragments of cuticles have been obtained, showing small elliptic stomata of probably anomocytic type, 12-15 µm long, with a narrow pore. Uniseminar pods of typical form.

Remarks. Abundant remains in the Cypris Shale vary in size and shape, although the only complete leaf shows much less variability among the leaflets. The differences may be due to exposition of the leaves or different habitat conditions. The fruits have rarely been found.

After a detailed systematic study Herendeen (1992a) rejected an affinity of this species to *Gleditsia* L. as suggested by Gregor and Hantke (1980). In his opinion it belongs to an extinct genus closely allied to the tribes Dentarieae - Amherstieae. For the nomenclature see Herendeen (1992b).

Occurrence. Cheb Basin - majority of cores studied, Pochlovice; Sokolov Basin - Dukla and Medard Mines.

Fabaceae gen. et sp. div.

1880 *Cassia palaeocrista* nov. sp.; Engelhardt, p. 16, pl. 8, fig. 21.
1880 *Cassia phaseolites* HEER; Engelhardt, p. 17, pl. 7, fig. 6.
1880 *Cassia fischeri* HEER; Engelhardt, p. 17, pl. 7, fig. 2, pl. 9, fig. 1c.

Description. A suite of small, elliptic entire-margined leaflets, partly mucronulate, with camptodrome venation. Short petiolule is wrinkled across, in one case attached to the rest of the rhachis. A pod, rather wide and short, with slightly thickened margins. Sparse, mostly rather oblique veins run from both margins and form an irregular network of larger meshes (venation poorly visible). No traces of seeds.

Remarks. The legumes and foliage of such a type can be observed in numerous genera among Leguminosae s. l. (e.g. *Cassia* L.), Therefore the affinity of the specimens remain uncertain.

Occurrence. Cheb Basin - core HV 13, 158-159 m, Mokřina.

Theaceae

Gordonia hradekensis (KVAČEK et BŮŽEK) BOZUKOV et PALAMAREV

Pl. 27, fig. 9, pl. 28, figs 3-5

1966 *Symplociphyllum hradekense* sp. n.; Kvaček and Bůžek, p. 293, pl. 2, figs 5-6, pl. 3, fig. 1, pl. 4, figs 8-9.
1984 *Polyspora hradekensis* (KVAČEK et BŮŽEK) KVAČEK et WALTHER comb. nov.; Kvaček and Walther, p. 335, pls 57-59.
1995 *Gordonia hradekensis* (KVAČEK et BŮŽEK) BOZUKOV et PALAMAREV comb. nov.; Bozukov and Palamarev, p.182, text-fig. 7.

Description. Leaves with crenulate margin and characteristic epidermal structure have been treated in a separate study (Kvaček and Walther 1984). *Polyspora* SWEET is generally included into the genus *Gordonia* ELLIS (Grote and Dilcher 1992, Bozukov and Palamarev 1995).

Occurrence. Cheb Basin - core HV 16, 58-59 m; Sokolov Basin - Dukla Mine.

Ternstroemia sequoioides (ENGELHARDT) BŮŽEK et HOLÝ comb. n.

Pl. 22, figs 11-14

1880 *Carpolithus sequoioides* nov. sp.; Engelhardt, p. 20, pl. 9, fig. 19 (basionym).
1957 *Capparidispermum boveyanum* sp. n.; Chandler, pp. 98-99, pl. 15, figs 92-96.
1971 *Ternstroemia boveyana* (CHANDLER) comb. n.; Mai, pp. 332-333, pl. 35, fig. 42.

Description. Impressions of flat campylotropous seeds, widely ovate to ovate in outline. Length 4.75-5.6 mm, width 3.5-3.9 mm, length/width index 1.35-1.44. Strongly twisted embryonal cavity in the shape of a bent U; longer micropylar part strongly convex, parallel with the seed margin, shorter opposite part S-shaped. Condylus of a horizontal C-shape. Margin in the hilum area straight, margin at the micropylar part of embryonal cavity strongly convex, the opposite margin slightly arched to almost straight, but not convex. The width of border suture at the convex margin 0.3-0.5 mm, at the straight or slightly arched margin 0.75-1.15 mm. The surface of testa covered with flattened papillae (c. 0.15 mm across), arranged parallel with the course of seed twisting.

Remarks. The recovered seeds differ from the specimens described by Chandler (1957) as *Capparidispermum boveyanum* only by slightly larger dimensions and a more bent condyle (in the sense of the emended diagnose by Mai 1971). The type of Engelhardt's *Carpolithus sequoioides*, deposited in the Staatliches Museum für Mineralogie und Geologie zu Dresden (No. 7, D 116) is identical with two of our specimens (see pl. 22, fig. 11). It is 3.75 × 5.15 mm in size, the surface is somewhat weathered, without distinct papillae. Kirchheimer (1957) did not mention this taxon in his catalogue, perhaps influenced by Engelhardt's view that this seed belonged to a Conifer. Because of the priority, a new combination is proposed to replace *T. boveyana* (CHANDLER) MAI.

A very similar species *T. chandlerae* HOLÝ (1977a) differs by its more slender shape (lentgh/width index 1.45-1.75), less bent condyle, and sutures of almost the same length. *T. rugata* (REID et CHANDLER) HOLÝ differs by a distinctly emarginate hilum, slightly concave margin with a shorter, S-shaped shoulder of the embryo cavity, and by its rugose testa surface. *T. bartonesis* (CHANDLER) MAI (see Chandler 1960, Mai 1971) differs with a slightly bent condyle, almost terminal hilum, slightly S-shaped and shorter part of embryo cavity and transversally arranged sculptural testa elements.

In the North Bohemian Basin this species was found at several stratigraphical levels and described erroneously by Bůžek and Holý (1964) as *Potamogeton* sp.

T. sequoioides occurs in Europe from the Upper Oligocene to the Middle Miocene (Mai 1971, Mai and Walther 1991).

Occurrence. Cheb Basin - core HV 12, 109 m; Sokolov Basin - Královské Poříčí (coll. Engelhardt, MMG - holotype).

Salicaceae

Populus populina (BRONGNIART) KNOBLOCH

Pl. 9, fig. 6, pl. 15, fig. 2

1822 *Phyllites populina* BRONGNIART; Brongniart, p. 237, pl. 14, fig. 4.
1964 *Populus populina* (BRONGNIART) comb. n.; Knobloch, p. 601.

Description. Leaves broadly transversally oval to broadly triangular, truncate to very widely cuneate at base, obtusely acuminate, widely coarsely crenulate-dentate with glandular teeth. Venation semi-craspedodrome to craspedodrome, some secondaries and basal veins giving off abmedial side veins that enter teeth, the other, partly forked near the margin, directly enter teeth. Tertiary and higher-order venation hardly visible, irregularly reticulate. Petiole very long, thin. Texture rather thick, but not coriaceous.

Remarks. This suite of three leaves resembles poplar foliage and the glands on the margin are of the salicoid type sensu Hickey and Wolfe (1975). In contrast to the leaf forms occurring in the North Bohemian Basin (Bůžek 1971), teeth are more distinct, and broadly triangular, resembling in this way the populations from Oehningen. An aquatic plant *Trapella* OLIV. (Pedaliaceae) has morphologically similar foliage (Miki 1967).

Occurrence. Cheb Basin - core HV 6, 91-92 m, Pochlovice.

Symplocaceae

Symplocos lignitarum (QUENSTEDT) KIRCHHEIMER

Pl. 20, fig. 2

1867 *Carpolithus lignitarum*; Quenstedt, p. 914, pl. 86, figs 35, 41.
1949 *Symplocos lignitarum* (QUENSTEDT) KIRCHHEIMER; Kirchheimer, pp. 14-15, pl. 1, fig. 4, pl. 2, fig. 15.

Description. A compressed endocarp, 4.2 mm long and 3.5 mm wide, probably trilocular, shortly cylindrical-oval, with convex sides. Base slightly narrowed, rounded, apex blunt, with a wide pit. Surface with conspicuous, angular, meridional, low ribs running along the whole length of the endocarp.

Remarks. The specimens belong to the group of less typical endocarps, more barrel-shaped than cylindrical. It is one of the most abundant Tertiary species of *Symplocos* (Upper Oligocene to Pliocene). Similar forms occur in the strata overlying the upper seam at Hrádek n. N.

Occurrence. Cheb Basin - core HV 12, 63-64 m.

Symplocos minutula (STERNBERG) KIRCHHEIMER

Pl. 20, fig. 3

1925 *Carpolithes minutulus*; Sternberg, pp. 44, XVI, pl. 53, fig. 8.
1949 *Symplocos minutula* (STERNBERG) KIRCHHEIMER; Kirchheimer, pp. 14-16, pl.1, figs 6 e-g, pl. 2, fig. 16 b.

Description. Very flattened endocarps, 5.5-8 mm long and 3.5 mm wide, slightly bent in longitudinal axis, of long ovate outline, perhaps bilocular. Surface mostly smooth, one specimen with preserved epidermis, finely longitudinally grooved.

Remarks. This species is rare in the Lower and Middle Miocene and occurs more often in the Upper Miocene. It probably is a member of the coal-forming vegetation. In the Zittau Basin and in Upper Lusatia it is recorded only rarely from two localities, and from Oberpfalz it is not recorded at all.

Occurrence. Cheb Basin - core HV 1, 136.4 m, HV 2, 94-95 m; Sokolov Basin - Medard Mine (errosion filling in the Antonín Seam).

Symplocos ludwigii KIRCHHEIMER

Pl. 20, fig. 4

1949 *Symplocos ludwigii* KIRCHHEIMER; Kirchheimer, p. 16, pl. 1, fig. 8.

Description. Fruits mostly secondarily flattened, bilocular, 7 mm long and 4-5.3 mm wide, oval to shortly and widely oval, narrowed to apical pit. Apical pit surrounded by the margin of a short neck. Most fruits slightly bent. Coriaceous endocarp shallowly grooved, grooves (possibly with vascular bundles, if preserved) sparsely and steeply anastomosing.

Remarks. The species occurs till the Pliocene and is known mainly from coal deposits (e.g. Dorheim, see Kirchheimer 1957). Its status is not well known.

Occurrence. Cheb Basin - cores HV 1, 156.4 m, HV 5, 63-64 m, HV 11, 86-87 m, HV 18, 72-73 m, HV 19a, 76-77 m, V 5, 60-61 m.

Sphenotheca cf. *incurva* KIRCHHEIMER

Pl. 27, fig. 10

? 1934 *Sphenotheca incurva* sp. nov.; Kirchheimer, p. 789, text-fig. 19.

Description. Almost symmetrical, oval fruit, 20 mm long and 11 mm wide, at the apex narrowed into a characteristic neck and broadened into a collar (6 mm across) around a slightly oblique apical pit. Pit surrounded by a thick rim of the exocarp. Exocarp formed by a thick layer of lignified, black, carbonized, unusually large parenchyma cells. The endocarp penetrates, with a thin inner border, to the base of the apical pit. Endocarp tissue sclerenchymatous, brownish.

Remarks. *Sphenotheca incurva* is an extinct type probably related to Symplocaceae. It is known as a rare element of the younger mastixioid floras in warm phases of the Miocene in Central Europe.

Occurrence. Cheb Basin - core HV 9, 63-64 m.

Styracaceae

Sinojackia sp.

Pl. 20, fig. 5

Description. Broadly spindel-shaped fruit, 20 mm long, with maximal width 7 mm in the lower third, longitudinally ribbed, with c. 6 probably low but distinct ribs, some of them furcate, continuing on the narrowed conical apex. Apex contracted into apical extension. A short fruit stalk preserved.

Remarks. Identical fruits are usually described as *Halesia crassa* (C. et E. M. REID) KIRCHHEIMER. Such fruits, however, occur also in *Pterostyrax* SIEB. et ZUCC. and especially in *Sinojackia* HU. The latter genus is most similar. *Pterostyrax* has fruits without an apical extension (woody style), which is prominent in the winged fruits of *Halesia* ELLIS (see also Kirchheimer 1957). *Pterostyrax corymbosa* SIEB. et ZUCC. also has fruits with a similar apical extension, but with narrow wings (Miki 1968).

Occurrence. Sokolov Basin - Dukla Mine.

Tiliaceae

Tilia sp.

Pl. 20, fig. 8

Description. A fragmentary bract, 60 mm long and 1.2 mm wide (complete length c. 80 mm), elongate, narrowed towards the apex, entire-margined, margin slightly wavy. Midrib strong up to half of the preserved length, where it forks and both branches run into the apex. Secondaries widely spaced, irregular, looping along the margin (complex camptodrome venation). Peduncle seen in the compression, the part stretching over the bract branched once. Bract with dark traces on the surface (? parasitic fungi or trichomes). Texture membranous.

Remarks. The bract probably belongs to those species, in which the peduncle merges with the bract for some distance - contrary to specimens from the North Bohemian Basin, which are newly ascribed to a new species with non-decurrent bracts, *Tilia brabenecii* BŮŽEK et KVAČEK, and a number of other records of the genus (see Bůžek and Kvaček 1994).

The fragmentary specimen at hand does not allow a more precise determination, because important characters, e.g. fruits, pubescence, are not available. Only pollen of *Tilia* was reported from the Cypris Shale. No leaves of this kind have been recovered.

Occurrence. Sokolov Basin - Dukla Mine.

Craigia bronnii (UNGER) KVAČEK, BŮŽEK et MANCHESTER

Pl. 20, fig. 16

1845 *Ulmus bronni* UNG.; Unger, p. 79, pl. 25, figs 2-4 (non fig. 1).
1948 *Pteleaecarpum bronni* (UNG.) WEYLAND; Weyland, p. 130, pl. 21, fig. 5, text-figs 5-9.
1991 *Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER, comb. nov.; Kvaček, Bůžek and Manchester, p. 522.

Remarks. Detached capsule valves occur very rarely in the Cypris Shale facies. Structural details and generic affinities have been recently discussed by Bůžek, Kvaček and Manchester (1989) and Kvaček, Bůžek and Manchester (1991).

Occurrence. Cheb Basin - cores HV 8, 119-120 m, HV 16, 38-39 m; Sokolov Basin - Dukla Mine.

Buxaceae

Buxus egeriana KVAČEK, BŮŽEK et HOLÝ

Pl. 28, figs 1-2

1982 *Buxus egeriana* sp. n.; Kvaček, Bůžek and Holý, p. 362, pls 1-2, pl. 5, fig. 6.

Remarks. Leaves with epidermal structure and detached fruits recovered in the Cypris Shale as rare accessories have been discussed in a separate paper (Kvaček, Bůžek and Holý 1982).

Occurrence. Cheb Basin - cores HV 9, 109-110 m, 115-116 m, HV 12, 109-111 m, HV 13, 204-205 m, HV 14, 225-226 m; Sokolov Basin - Dukla Mine.

Rutaceae

Toddalia maii GREGOR

Pl. 24, fig. 9

1975b *Toddalia maii* sp. n.; Gregor, p. 125, text-fig. 5.
1978b *Toddalia maii* n. sp.; Gregor, p. 26-27, pl. 6, figs 5-7, text-figs 2-4.

Description. Seeds of half-moon outline, reniform, with flat lateral sides, 3.3-3.33 mm long, 2.25-2.5 mm wide. Both ends rounded, unequally arched. Hilar scar not deep, 1.3 mm long. Micropylar end slender, the opposite one more rounded (in one of the seeder) rather twisted above the wider end of hilar scar. The surface of the seed densely fine dotted. On the bedding plane of the sample from the core HV 11, fruits composed of 9 seeds have deen found. The seeds were originally surrounded by thin and easily detachable coriaceous exocarp. The individual seeds are c. 2.6 mm large and arranged around a central column-like segments in an orange fruit. The size of the fruit is c. 3.4 to 3.75 mm in apical view.

Remarks: This special is known from several localities of the European Early Miocene (North Bohemian Basin, Niederpleis, Wackersdorf, Turów). For details see Gregor (1979).

Occurrence: Cheb Basin - cores HV 8, 142 m, HV 11, 86 m, HV 18, 30-31 m; Sokolov Basin - core 25 H, 47-48 m.

Zanthoxylum cf. *ailanthiforme* (GREGOR) GREGOR

Pl. 20, fig. 7

? 1975b *Rutaspermum ailanthiforme* sp. n.; Gregor, p. 122, text-fig. 2.
? 1978b *Zanthoxylum ailanthiforme* (GREGOR) n. comb.; Gregor, p. 30, pl. 1, figs 1-4, text-figs 2 a, 5.

Description. Semianatropous seeds of slightly asymmetrical, ovate outline, with the dorsal side completely rounded, the ventral side less arched. Length 3.1-2-3.57 mm, height 2.4-2.9 mm. Sides considerably arched. Hilar scar c. 2.8 mm long (i.e. 4/5 of the seed length), shallow, situated on a narrow and low keel, bordered by tiny ridges, and narrowing lengthwise and acutely towards the micropylar end. The aperture of raphe is under a small beak-like protrusion. In the apical view the micropylar end is narrowed into a blunt edge, the opposite end is rounded. The surface with conspicuous protuberances, among which shallow irregular lacunae arise. These are elongate at the hilar end. The wall of the testa is formed by isodiametric sclerenchymatic cells, appearing on the outer surface as fine pits.

Remarks. This species differs from *Rutaspermum kristinae* HOLÝ (1977a) from Hrádek n. N., also a member of the genus *Zanthoxylum* L. (see Gregor 1978b), by its symmetrically developed sides, much longer and narrower hilar scar and an inconspicuous beak-like protruberance of the raphe. *Z. rugosum* CHANDLER (1962) is smaller, reniforme in outline, with a deep hilar scar. *Z. exacartum* CHANDLER (see Chandler 1957) has a shorter hilar scar, and a coarsely verrucate surface. The most similar in shape is *Z. ailanthiforme* from Wackersdorf (Gregor 1975b), which differs from our seeds only by an arch-like micropylar end.

Occurrence. Cheb Basin - cores HV 16, 37.6 m, HV 18, 49-50 m.

Simarubaceae

Ailanthus confucii UNGER

Pl. 21, figs 8-9

1859 *Ailanthus confucii* UNG.; Heer, p. 87, pl. 127, fig. 36.

Description. Winged fruits with endocarp centrally positioned, approximately 20 mm long and 8 mm wide (according to incomplete specimens), long oblong in outline, narrower towards the base than towards the apex, base cuneate, apex missing in all specimens, in one case probably blunt. Venation longitudinal, converging towards both ends. Endocarp roughly ovate, placed obliquely in the fruit, acute apical end facing the ventral side, opposite end rounded, in its upper side strikingly straight. Endocarp surface covered by imprinted, distinctly branched venation, coming from the ventral side, from the marginal vascular bundle, and gradually narrowing.

Remarks. Our specimens match in size and form of the wing, as can be seen in fragmentary material, with the fruits assigned to *A. confucii* (Heer 1859, Unger 1866, Weyland 1937, Žilin 1967). In addition, other records obtained by washing and described under the same name (Negru 1972) or as *A. tertiaria* DOROFEEV (1963, in Kolakovskij 1958) are similar in the venation covering the endocarps, and in their size and shape. *A. confucii* represents a rather young element in the European Tertiary, because it is more common in the Upper Miocene in Europe, while in Asia it seems to be more abundant in the Oligocene (Krištofovič et al. 1956, Žilin 1967). The Oligocene records of *Ailanthus* in Europe are probably not conspecific with the Miocene specimens. Further Lower and Middle Miocene occurrences of *A. confucii* are known from Hungary (Pálfalvy 1950, 1965) and Roumania (see Sitár et al. 1978). It is rather surprising that almost all our specimens have been recovered in one core, HV 8 at the depth 110-120 m.

The fruits and endocarps of this species have usually been compared with the modern *A. altissima* (MILL.) SWINGLE (= *A. glandulosa* DESF. = *A. peregrina* (BUCHHOLZ) F. A. BARKLEY), growing as a tall tree in the forests of southern China. Our comparisons reveal that the mentioned modern species probably has a larger average fruit size. Therefore, it is interesting to note that the Lower Oligocene records from Hungary are larger and more similar to *A. altissima* than those from younger strata of the Hungarian Tertiary (Andreánszky 1959, 1966).

The legitimacy of the epitheton "*confucii*" was confirmed by Žilin (l. c.). We also agree with his opinion that the name cannot be used for the leaf remains connected with the fruits without any evidence. Even in this circumstance *A. confucii* is probably a cumulative species.

Occurrence. Cheb Basin - cores HV 8, 110-111 m, 112-113 m, 119-120 m, 137-138 m, HV 11, 56 m.

Oleaceae

Fraxinus sp.

Pl. 21, figs 1-5

Description. Leaflets elongate to obovate, finely toothed, secondaries slightly bent, thin, giving off side tertiaries that enter tooth sinuses. Intercostal tertiaries loose, irregular, poorly visible due to carbonized leaf lamina. Fruits with distal wing, elongate in shape, up to c. 30 mm long and of maximum width of 5 mm in the middle of the length, at the base of the fruit body cuneate to narrow cuneate, apex missing. Fruit body strikingly dark (structureless coal matter), probably thicker and firmer. Wing in relation to fruit body not too long, membraneous, with fine, parallel venation without a distinct midvein, connected by very fine, cross veins.

Remarks. Poor preservation does not allow more detailed comparisons with the modern species, the generic assignment is obvious. Outlines of seed are not visible in the fruit bodies. Hence the fruit may be barren or juvenile. Some of the fruit remains are without wings, having been devoid of them probably due natural maceration.

Occurrence. Cheb Basin - cores HV 3, 119-120 m, HV 4, 80-81 m, HV 6, 105-106 m, HV 8, 131-132 m, 138-139 m, HV 12, 111 m, HV 14, 220-221 m; Sokolov Basin - Dukla Mine.

Lythraceae

Decodon globosus (E. M. REID) NIKITIN

Pl. 22, figs 7-10

1920 *Diclidocarya globosa* sp. n.; Reid, p. 81, pl. 4, fig. 24.
1929 *Decodon globosus* (E. M. REID) NIKITIN; Nikitin, pp. 33-36, pl. 589, figs 1, 3, 5, 7.

Description. Obovate seeds of very irregular shapes, often compressed from sides, sometimes in the shape of a very rounded irregular tetrahedron. Size 0.9-1.25 mm.

Remarks. Information about this rare species has been until recently scanty. Mai (1967) noted it from the Lower Miocene, and there are reliable records from the Miocene of Poland (Rypin, Stare Gliwice) and from the Pliocene in the Netherlands and Belgium. In western Siberia it already appears in the Upper Oligocene, but mainly in the Miocene and Pliocene. It is rare in the Lower Miocene of the North Bohemian Basin and it has also been lately described from the Ottnangian to Badenian of southern Moravia (Knobloch 1978). Further records of *Decodon* have been noted by Knobloch (1980, 1981) from the Sarmatian of the Orava Basin and from the Pannonian at Hodonín (the latter record as *D. gibbosus (*C. M. REID, NIKITIN). Negru (1972) described it from the Lower Sarmatian of Bursuk, further records from the European part of Russia are also known (see also Bůžek and Kvaček 1985).

Decodon is at present a hydrophilous plant of the eastern U.S.A. (from Rhode Island to Florida) growing on low muddy banks of stagnant and running waters. It enters into shallow waters as well.

Occurrence. Sokolov Basin - Medard and Jiří Mines (errosion fillings in the Antonín Seam).

Rhamnaceae

Ziziphus paradisiaca (UNGER) HEER

Pl. 21, figs 6-7

1850c *Daphnogene paradisiaca* UNG.; Unger, p. 167, pl. 38, figs 1-7.
1859 *Ziziphus paradisiaca* UNG. sp.; Heer, p. 74.

Description. Leaves triveined, with a stout petiole (incomplete length 5 mm), obliquely asymmetrically ovate, c. 45 mm long and 25 mm wide, with the maximum width around the lower third, base asymmetrical, apex missing. Margin in the lower leaf half entire, higher up inconspicuously and sparsely serrate, teeth spaced at intervals of c. 5 mm, slightly S-shaped, tightly appressed. Primaries acrodrome, distinct, the middle vein thicker, the lateral ones springing from the petiole and running sub-parallel with the margin, nearer to the margin than to the midvein; secondaries either not visible or not formed, tertiary veins running from the midvein at an angle of c. 90°, horizontal, rather thick, marginal tertiary veins in the same direction, only more oblique, forming marginal loops. Abmedial veinlets from the loops enter sinuses. Higher-order venation forms a fine network of free ending veins. Texture evidently thin.

Remarks. Heer (1959) transferred this species, which he knew from the autopsy (the material from Radoboj), to *Ziziphus* P. MILL. as he considered the asymmetry of the leaves and indistinctly serrate margin. He compared it with the modern *Z. celtidifolia* DC. from Java. Of the many species of this genus, we have studied a smaller part. None of the examined modern species correspond precisely with our specimens. Only *Z. incurva* WALL. from Nepal shows certain similarities in the shape of leaves, their base and marginal teeth, but differs in venation. Side veins run approximately in the middle between the midvein and the margin or nearer the midvein, tertiary horizontal venation is missing. Marginal teeth are more dense (two teeth in 5 mm).

Our specimens match well with the type specimens as well as with the material from Aix (Saporta 1862), and also with *Z. paradisiaca* var. *paradoxa* E. M. REID et CHANDLER (1926) from Bembridge. The latter variety differs, however, in the larger density of marginal teeth and in the character, on which the variety is based - the presence of secondaries in the apical part of the leaf. As stated by the authors, this variety combines the features dispersed now throughout the whole genus. They found strictly horizontal tertiaries in some species of eastern Asia, e.g. *Z. glabrata*. However, we cannot confirm this observation.

Z. paradisiaca has been recorded in the Hungarian Middle Miocene (Pálfalvy 1950, 1965, Kretzoi and Pálfalvy 1967), unfortunately without detailed description and illustration, but we can confirm the occurrence at Magyaregregy from own observation of the material.

A more slender form of such leaves is commonly called *Z. ungeri* HEER or *Z. zizyphoides* (UNG.) WEYL. (e.g. in Petrescu 1968). This species has much less horizontal tertiary venation, which is rarely visible, and differs in several other ways from broader forms. The broader forms with reduced marginal teeth can occur in association with slender ones, which are described from the Roumanian Pannonian also as the modern *Z. jujuba* MILL. (Petrescu 1968). This modern species is probably a relic of one or two Tertiary taxa, which survived in Central Europe from the Paleogene till the Middle Miocene, in the Balkan area till the Pannonian or till the present.

Occurrence: Cheb Basin - cores HV 6, 115 m, HV 12, 87-88 m, HV 18, 55-56 m, V 5, 41-42 m, Mokřina.

Vitaceae

Tetrastigma sp.

Pl. 23, figs 4-5

Description. A seed, oval in outline, with short, massive micropylar stalk at the base. Margin only slightly undulate, not angular, chalaza probably narrowly oval, rib-like grooving starting radially from it.

Remarks. The seed is longitudinally broken in the level of the bedding plane and only an approximate determination is possible. The observable features are more similar to *Tetrastigma* PLANCH. than to *Cayratia* JUSS., which has seeds of distinctly trigonal shape and angular margins (Miki 1956).

Occurrence. Sokolov Basin - Dukla Mine.

cf. *Tetrastigma* sp.

Pl. 23, figs 1-2, pl. 24, figs 1-4

Description. Compound, imparipinnate leaf with 3 or 4 or even more leaflets, of which the terminal one is the largest. Leaflets entire-margined, undulate to inconspicuously dentate. Secondaries entering marginal sinuses, venation poorly visible, disappearing in coal matter, only tertiary veins running arch-like between the secondaries slightly discernible.

Remarks. The mutual position of detached leaflets indicates that they belong to a single compound leaf. Morphologically similar leaves occur in *Tetrastigma*. The determination could not be cofirmed by anatomical study.

Occurrence. Cheb Basin - core HP 7P, 31-32 m; Sokolov Basin, Dukla Mine.

cf. *Cayratia* sp.

Pl. 23, fig. 3

Remarks. An interesting leaf with a naturally separated blade segment at the base. Similar segmentation of the basal part of the leaf blade can be found e.g. in terminal leaflets of compound leaves in *Cayratia gracilis* (GUILL. et PERR.) SUESSENG., but in this species the leaflets are more densely dentate. The affinities of this specimen remain doubtful.

Occurrence. Cheb Basin - core HV 4, 91-92 m.

Ampelopsis cf. *rotundatoides* DOROFEEV

Pl. 24, figs 5-8

? 1957 *Ampelopsis rotundatoides* sp. n.; Dorofeev, p. 645, text-figs 2/1-4.

Description. A seed of rounded outline, secondarily very flattened, 2.8 mm long and 2.6 mm wide. Base suddenly narrowed in a very short small beak-like projection, blunt at the end. Apex rounded, without an incission (the impression with the incission). Chalaza rounded, 0.7 mm across. Keel on the ventral side flat, very wide, narrowing towards the base, both lateral folds of the testa diverging from the base, and of a long and narrow drop-like outline. Testa composed of radially disposed, elongate sclerenchym cells, 0.08-0.1 mm thick. Some of the features observable on the impression and the counterpart of another specimen.

Remarks. *Ampelopsis rotundatoides* from the Oligocene of western Siberia (Dorofeev 1963) differs from the above described carbonized seeds in a rather more elongate chalaza and a somewhat larger basal beak. A similar but twice as large seed was described by Szafer (1947) from Krościenko as *Vitis cordifolia* MCHX. foss.

Occurrence. Cheb Basin - core HV 1, 144-145 m; Sokolov Basin, Dukla Mine.

Parthenocissus sp.

Pl. 23, figs 6-7

Description. Two seeds of obliquely or straight widely cordate-obovate, or widely obovate outline. Size 3.5 × 3.0 mm and 2.0 × 1.5 mm. Base widely cuneate, narrowed in a very short and small beak. Apex not deeply incised by the groove of raphe. Dorsal side smooth, slightly convex, without distinct chalaza, only with a fine groove. Ventral side with a flat and wide keel of raphe, showing a converging fine groove. Both lateral folds of testa narrow, diverging from the base towards the apex at an acute angle in one specimen, and at much wider angle in the other one.

Remarks. The seeds show relations to the group of species growing in China and America, e.g. *Parthenocissus tricuspidata* (SIEB. et ZUCC.) PLANCH. and *P. quinquefolia* (L.) PLANCH.

Occurrence. Cheb Basin - cores HV 18, 43-44 m, V 1, 54-55 m.

Aceraceae

Acer tricuspidatum A. BRAUN et AGASSIZ

Pl. 25, fig. 6, pl. 28, fig. 6

1838 *Acer tricuspidatum* A. BRAUN et AGASSIZ; Bronn, p. 865, pl. 25, figs 10 a-b.
1880 *Acer trilobatum* STERNB. sp.; Engelhardt, p. 13, pl. 8, figs 9-11.

Description. The recovered leaf remains agree in morphology with the material described by Procházka and Bůžek (1975). One leaf fragment has typical features of the epidermis: cells of the adaxial epidermis with slightly bent anticlines, outer periclinal walls slightly striated, abaxial epidermis covered by strongly cutinized simple trichomes, stomata anomocytic, round-quadrangular to elliptic, 12-15 µm long, with prominent ledges.

Remarks. Maple leaves are, contrary to the large number of samaras, very rare and incomplete. Engelhardt (1880) also described, as *A. trilobatum* STERNB. sp., rare and fragmentary specimens from Jehličná. Therefore we are not quite sure of the occurrence of *A. tricuspidatum* on the basis of the very fragmentary specimens we studied. Some of the samaras are at least of the form belonging to this leaf type. One of the leaves' wide middle lobe resembles the form "*crenatifolium*", another's shorter lateral lobes the form "*productum*", and the third specimen has very reduced lateral lobes which corresponds to the form "*bruckmanii*". The epidermal structure of one leaf fragment exactly matches the material described as *A. tricuspidatum* by Walther (1972).

As we do not know the extent of the variation of this population, we also cannot exclude from comparisons the modern *A. ginnala* MAXIM. and *A. velutinum* BOISS.

Occurrence. Cheb Basin - cores HV 4, 96.4 m, HV 11, 49.4 m, 85.6 m, Pochlovice; Sokolov Basin - Dukla Mine, Jehličná.

Acer cf. *pseudomonspessulanum* UNGER

Pl. 26, fig. 9

? 1847 *Acer pseudomonspessulanum* UNG.; Unger, p. 132, pl. 43, figs 1(?)-2.

Description. One leaf is fragmentary, the other one has rather narrow and long lobes, with slightly indicated teeth on the lateral lobe, and the third leaf has a short and extremely wide lobe (similar as in *A. creticum* L.).

Remarks. Similar leaf forms are known from Holedeč in the North Bohemian Basin (Procházka and Bůžek 1975). The systematic position of these leaf forms from the Cypris Shale has not been elucidated so far. First of all it is not certain whether all of them belong to a single species. Generally they recall extant species of sect. *Goniocarpa* POJARK. ser. *Monspessulana* POJARK. but one leaf also shows features of the representatives of sect. *Platanoidea* PAX ser. *Picta* POJARK. (e.g. strikingly narrow long lobes). Their relations to the other leaf forms of the Cypris Shale, described below as *A.* cf. *integrilobum* WEBER and *A.* cf. *integerrimum* (VIV.) MASSAL. are not quite clear. More material will be necessary for further study.

Ferguson (1971) described interesting remains as *Acer* sect. *Platanoidea* PAX (taxon XXXIII). The anatomical structure of the epidermis suggests relations to the group of species of the section *Platanoidea*, but extreme forms with small lobes on the middle lobe more closely resemble the leaves of *A. campestre* L. from the same section (or from the section *Campestria* PAX sensu OGATA).

Occurrence. Cheb Basin - cores HV 8, 135-136 m, HV 11, 59-60 m, HV 18, 52-53 m.

Acer angustilobum HEER

Pl. 26, fig. 2

1859 *Acer angustilobum* m.; Heer, p. 57, pl. 117, fig. 25a, pl. 118, figs 4-7.

Description. A single leaf with its counterpart, corresponds in its narrow, simple bluntly dentate lobes, which make nearly right angles, with the type populations at Oehningen. Another coarsely dentate leaf with the basal part of the middle lobe without teeth resembles some forms of *A. dasycarpoides* HEER sensu PROCHÁZKA from the České Středohoří Volcanic Complex (Procházka and Bůžek 1975).

Remarks. Procházka and Bůžek (1975) reduced this species to a form of *Acer dasycarpoides* HEER, but this concept was not confirmed by cuticular studies. Therefore we follow Walther (in Mai and Walther 1991) and maintain *A. angustilobum* as an independent form species.

Occurrence. Cheb Basin - Pochlovice; Sokolov Basin - core 25 H, 50-51 m.

Acer cf. ***integrilobum*** WEBER

Pl. 25, fig. 13

? *Acer integrilobum* m.; Weber, p. 196, pl. 22, figs 5 a-(?)b.

Description. Leaves less dentate, but with two distinct teeth on the middle lobe, one specimen with much reduced lateral lobes (like in the extant *A. ibericum* M. B.).

Remarks: Palamarev and Kitanov (1977) consider *A. integrilobum* as a variety of *A. integerrimum* WEBER. However, the relationship of these nearly entire-margined trilobed leaves has not been fully clarified.

Occurrence. Cheb Basin - core HV 4, 77-78 m; Sokolov Basin - core 25 H, 50-51m, Dukla Mine.

Acer cf. ***integerrimum*** (VIVIANI) MASSALONGO

Pl. 26, fig. 1

? 1833 *Acerites integerrima* VIVIANI, p. 131, pl. 11, fig. 6.
? 1858 *Acer integerrimum* VIVIANI sp.; Massalongo, p. 94.
? 1859 *Acer integerrimum* VIVIANI sp.; Massalongo and Scarabelli, p. 341, pl. 18, fig. 3.

Description. One leaf with elongate apices of lateral lobes very similar to *A. integerrimum*.

Remarks. It is improbable that this leaf may represent an extreme form of *A. pseudomonspessulanum*, because in the series *Monspessulana* such forms with elongate apices do not occur. It may also belong to *A. integrilobum*.

Occurrence. Cheb Basin - cores HV 4, 77-78 m, HV 18, 48-49 m.

Acer sp. div.

Pl. 25, figs 1-5, 7-12, pl. 26, figs 3-8

1880 *Acer trilobatum* STERNB. sp.; Engelhardt, p. 13, pro parte, pl. 8, fig. 12, pl. 9, figs 1 a-b.

Description. A rather large quantity of samaras or endocarps (naturally macerated and isolated on the bedding planes) can be differentiated into 4 groups (? independent species). The first type includes small samaras with larger endocarps (the wing is only three times longer). The suture makes angles of 30-40° with the dorsal line of the wing. The second type is very similar (if not identical), but the wing is broadly attached. The suture makes angles of 30-45° with the dorsal line of the wing. The third type, to which also the only recovered double samara belongs, has wide wings, narrowed mostly in the proximal part. The part with the endocarp is quadrangular and the suture makes an angle of 30° with the dorsal line, in some specimens the lines are parallel. The fourth type is very similar to the third one in the character of the endocarp part and the wing. It differs in the larger angle of the wing and the dorsal line reaching up to 45°.

Remarks. The first and second types resemble *A. rubrum* L. and may represent fruits of *A. tricuspidatum*. Double samaras similar to the recovered specimen of the third type are found in the section *Goniocarpa*, e.g. *A. hyrcanum* FISCH. et MEY., Transcaucasian region, Asia Minor, Iran, *A. turcomanicum* POJARK., Central Asia, Iran, with very variable, entire-margined to coarsely denate foliage. *A. ibericum* M. B., Caucasus, Transcaucasian region, Iran, has a similar connection of double samaras and sometimes leaves with short wide lobes (like in the specimen described above as *A.* cf. *integrilobum* WEBER). *A. assyriacum* POJARK., Kurdistan, is remarkably heterophyllic (fertile branches with almost entire-margined leaves). *A. stevenii* POJARK., Crimea, also has fruits of the third type. Similar fruits are also produced by *A. velutinum* BOISS. of the section *Gemmata* POJARK. with leaves regularly pentalobate.

If the first type represents only smaller samaras of the second type, and the fourth type is an extreme case of the third one, then only two natural species can be documented by fruits in the Cypris Shale.

Occurrence. Cheb Basin - majority of cores studied, Kaceřov, Pochlovice; Sokolov Basin, cores 25 H, 81-82 m, 84-85 m, 28 H, 82-83 m, 37 H, 16-17 m, Dukla, Družba and Medard Mines.

Sapindaceae

cf. *Sapindus falcifolius* (A. BRAUN) A. BRAUN

Pl. 27, figs 1-2

? 1836 *Juglans falcifolia* A. BRAUN; Buckland, p. 513.
? 1851 *Sapindus falcifolius* A. BRAUN; Stitzenberger, p. 87.

Description. Leaflets (?) shortly petiolate, entire-margined, narrow oval to lanceolate, with bent asymmetric base, the blade descending lower on the midvein in the convex side. Secondaries thin, dense, bent, with 2-3 intersecondaries of the same course. Higher-order venation forming elongate meshes parallel with the secondaries.

Remarks. The epidermal characters of the material available is not preserved. Another specimen of the same form from Hrádek n. N. shows the following details: the adaxial epidermis composed of small straight-walled cells, the outer side striate, the abaxial epidermis bearing anomocytic oval, hardly discernible stomata (15-20 µm long) and obovate serial glandular trichomes. Ferguson (1971) described similar, but poorly preserved structure of the same leaf type as taxon LIV. A preliminary survey of the leaf anatomy of Sapindaceae revealed that not only *Sapindus* L., but also *Koelreuteria* LAXMAN fit the above described characteristics well. The fruits of *Koelreuteria* often accompany the leaves described as *Sapindus falcifolius* (Oehningen, Tallya, Čermníky, Randecker Maar etc.) but not in the Cypris Shale.

Occurrence. Cheb Basin - cores HV 11, 41-42 m, HV 16, 42-43 m, Pochlovice; Sokolov Basin - Dukla Mine.

Sabiaceae

Meliosma pliocenica (SZAFER) GREGOR

Pl. 22, figs 3-4

1954 *Cicer pliocenicum* sp.n.; Szafer, pp. 40-42, pl. 9, figs 7-12.
1978a *Meliosma pliocenica* (SZAFER) comb. nov.; Gregor, p. 47, pl. 10, fig. 3.

Description. Endocarps almost rounded, secondarily very compressed, so that the chalaza is hidden in the fold between the two lateral sides. The inner texture of the chalaza has been identified in fragments. Size of a complete specimen 5.2 × 5.0 mm.

Remarks. The species also occurs in the strata underlying the Antonín Seam (previously identified as *M. wetteraviensis* (LUDWIG) MAI - Knobloch et al. 1975), where it is abundant. Mai (in Mai and Walther 1991) has recently referred to the specimens from the Cypris Shale as *M. miesleiri* MAI. Other records of *M. pliocenica* include the Lower Miocene of Wackersdorf (Gregor

1978b), the Middle Miocene of Stare Gliwice (Szafer 1961, as *M. europaea* C. et E. M. REID), the Pliocene of Duab (Dorofeev in Kolakovskij 1958, as *M. caucasica* DOROFEEV) and of Czorstyn and Krościenko (Szafer 1947, as *Cicer pliocenicum* SZAFER and *Zelkova serrata* MAR. foss.). *M. pliocenica* has smaller and more robust endocarps contrary to *M. wetterawiensis*. Comparable modern species are members of mesophytic forests of Chinese uplands or upland rain forests in Mexico (see Gregor 1978b).

Occurrence. Cheb Basin - cores HV 1, 96.5 m, HV 14, 228-229 m; Sokolov Basin - Medard Mine (erosion filling in the Antonín Seam).

Nyssaceae

Nyssa ornithobroma UNGER

Pl. 20, fig. 6

1860 *Nyssa ornithobroma* UNG.; Unger, p. 16, pl. 8, figs 15-18.

Description. One complete endocarp c. 14 mm long and 5.4 mm wide, unilocular, longly ovate elliptic, slowly narrowing towards the base. 12 or 13 longitudinal grooves on the surface. Dehiscent lid elongate to round triangular. Other fragmentary specimens with 2 to 3 locules.

Remarks. *N. ornithobroma* is known from azonal and transitional assemblages associated with the coal-forming sedimentation in the Oligocene and Miocene of Europe, Kazakhstan and western Siberia. Pliocene records are rare (Mai 1965, Kranichfeld).

Occurrence. Cheb Basin - core D 2, 13-13.5 m; Sokolov Basin - Medard Mine (erosion filling in the Antonín Seam).

Mastixiaceae

Mastixia amygdaliformis (SCHLOTHEIM) KIRCHHEIMER

Pl. 22, figs 5-6

1822 *Carpolithus amygdalaeformis;* Schlotheim, p. 98, pl. 21, fig. 7.
1957 *Mastixia amygdalaeformis* (SCHLOTHEIM) KIRCHHEIMER; Kirchheimer, p. 223, pl. 39, figs 155 a-e.

Description. One endocarp spindle-shaped elliptic, 16 mm long and 6 mm wide, length/width index 2.66. C. 10 longitudinal ribs or rows of protuberances on the surface, less distinct in the lower third. Base suddenly narrowed, blunt, apex shortly pyramidally extended by rib edges and continuation of the dorsal groove. Wall 0.8 mm thick, 1.25 to 1.5 mm on the ribs.

Remarks. The above described specimen is the only record of *M. amygdaliformis* in the Cypris Shale facies. Other records are Haidinger's classical material and other old collections probably made by Zippe (coll. National Museum, Prague). Their localities cannot be determined precisely, but they were certainly found in the environs of Cheb and Františkovy Lázně near Horní Lužná (Sorghof - Klausenhof, formerly also Záběl) and Dvoreček (Höflas - Maierhof). This material is not described in detail (see p. 6). *M. amygdaliformis* occurs also at Hluboká n. Vlt. in South Bohemia (Holý 1977b).

Occurrence. Cheb Basin - core HV 1, 146 m.

Cornaceae

Swida bugloviana NEGRU

Pl. 22, figs 1-2

1972 *Swida bugloviana* sp. nov.; Negru, p. 149, pl. 30, figs 1-12, text-fig. 39.

Description. Endocarps 3.4 × 3.0 mm in size, secondarily rather flattened, almost rounded, at the apex blunt along the dehiscence (due to deformation). Surface dull, corroded, without traces of vascular bundles. Most probably unilocular.

Remarks. The specimens described are larger than the types from the Sarmatian of Bursuk. Negru (1972) states that his specimens are also smooth. Szafer (1961, pl. 20, fig. 7) illustrates one specimen from Stare Gliwice, which completely matches our material. According to Negru (l. c.) also other records from the Polish Tertiary (Gdow Bay, Lower Badenian, Rypin, Middle Miocene) are also conspecific.

Of the modern species, *S. brachypoda* (C. A. MAY) SOJÁK, which grows with some other deciduous trees in the warm temperate zone in southern Japan, produces similar fruits.

Occurrence. Cheb Basin - core HV 5, 58-59 m.

Araliaceae

Hedera sp.

Pl. 20, fig. 1

Description. A leaf impression almost 40 mm long, trilobed, with long tapering middle lobe and small, short, probably blunt lateral lobes. Venation palmate, distinctly camptodrome in lobes. Lateral veins only slightly thicker than the midvein. Secondaries of the same direction as the lateral primaries, at the margin often anastomosing and joined into a marginal vein (or marginal thickening). Intersecondaries indistinct. Higher-order venation forming a fine network. Texture obviously fine.

Remarks. Saporta (1881) presented a survey of leaf forms assigned to *Hedera* L. Walther (1970) described a new species from Salzhausen on the basis of epidermis structure. Impression material was presented by Bajkovskaja (in Takhtajan et al. 1963). Our specimen resembles in size, shape and venation *H. philibertii* SAPORTA from Aix (Late Oligocene) but the type of this species differs in several ways (lateral veins abmedially bent, lateral lobes small, additional lobes at the base). The morphological differences may not express mere variation within one species, and there is also a considerable difference in the age of both records.

We have not found any modern species with identical leaf forms. Similar hastate forms are encountered in *H. pastuchovii* G. WORON. from Caucasus and Iran and *H. caucasigen* POJARK. from Caucasus and Turkey. According to Pojarkova (1950), sterile climbing branches of these species have rather polymorphic, thin coriaceous leaves of medium size (up to 10-12 cm long), 3-5(-7)-lobate, with some hastate forms showing the elongate middle lobe like our specimen. *H. taurica* CARR. from Balkan and Crimea is also similar in leaf morphology, but its foliage is more coriaceous than the preceding species.

Occurrence. Cheb Basin - core HV 9, 107-108 m.

Hydrocharitaceae

Stratiotes sp.

Description. Seeds fragmentary, cylindrical in outline. Apex round, base narrowed into a neck, with micropylar collar of knot-like shape, strikingly separated from the seed body, curved to the ventral side, below slightly more concave, not divided into two sides. Keel narrow running in a very fine crest to micropyle. Micropyle basiventral, strikingly ventrally orientated, including an angle c. 60° (?) with the seed axis. Aperture on a small protuberance situated on the collar under elongate ventral side. Raphe marginal, going into the suprabasal hilum. Longitudinal rows of very slender cells with wavy anticlinal walls forming the inner layer of testa. Sclerotesta finely dotted on the surface, covered by 10-11 longitudinal verrucate wrinkles on both sides or by rows of verrucate protuberances and crests. Micropylar collar more smooth, only with small protuberances.

Remarks. The material is identical with additional specimens from the seam equivalent west of Františkovy Lázně (core 4391) and differs from *S. kaltennordheimensis* (ZENKER) KEILHACK from the North Bohemian Basin (Holý and Bůžek 1966) in several features. It matches more with *S. sibiricus* DOROFEEV (1963) except for a slightly S-shaped form and basal position of the hilum in the latter. A fully reliable identification is hardly possible, and also difficult due to geographical and chronostratigrafical differences (Siberia, ? Upper Oligocene). The exact discrimination among these species is difficult without statistical evaluation of more numerous specimens.

Occurrence. Cheb Basin - cores V 12, 89.7-90 m, V 14, 68.4-68.6 m.

Smilacaceae

Smilax sagittifera HEER sensu HANTKE

Pl. 31, figs 1-2, pl. 32, figs 1-3

1855 *Smilax sagittifera* m.; Heer, p. 82, pl. 30, figs 7 a-b.

Description. Leaves 25-40 mm long and 35-40 mm wide, sometimes longer than wide, maximal width in the lower third, sagittate forms wider, with widely cuneate to cordate base, apex blunt, exceptionally emarginate, entire-margined, without thorns, with a thick midvein and thinner acrodrome secondaries. Higher-order venation camptodrome, not much distinct. Adaxial epidermis without stomata, anticlines almost straight, with indistinct lens-shaped thickenings (in coriaceous specimens), wavy to undulate (in most other cases). Abaxial epidermis smooth (or papillate in coriaceous specimens), with wavy anticlines. Stomata surrounded by 2-3(-4) lateral subsidiary cells, thus imitating the paracytic type. The guard cell pairs rounded to oval, 15-18(-21) µm long, with a boat-shaped pore and granular ledges. Density of stomata low, 85-100 per 1 mm square.The stomata arranged sub-parallel to the venation.

Remarks. Our material seems to be of gracile nature and evidently tend to the sagittate form. In most cases the base is cordate, with lateral lobes stretching outwards as the lamina in the lower third narrows. The leaf forms resemble most closely those of *S. obtusifolia* HEER and *S. obtusangula* HEER, which Hantke (1954) included into *S. sagittifera*. In spite of scanty material, the populations from the Cypris Shale differ from *S. weberi* WESSEL, which has larger and non-sagittate leaves and commonly occurs in the North Bohemian Basin (Bůžek 1971). Givulescu (1960) described a base very similar to that in our specimens as *S. sagittifera* from the Lower Pontian.

The epidermal structure, known in four of our specimens, matches in stomatal type the records of this genus which have been described (e.g. Hantke 1954, Ferguson 1971, Juchniewicz 1975, Knobloch and Kvaček 1976). The differences in the course of anticlines and other details, which we have encountered in our material, are obviously due to environmental conditions. The papillose abaxial epidermis has not been observed in *S. weberi* and may be specific to xeromorphic forms of *S. sagittifera* (see also description in Hantke 1954).

Occurrence. Cheb Basin - cores HV 1, 99-100 m, 162.8 m, HV 4, 96.5 m, HV 6, 92-93 m, HV 15, 89-90 m, HV 18, 48-49 m; Sokolov Basin - Dukla Mine.

Cyperaceae

Cladium sp.

Pl. 31, fig. 6

Description. Endocarps 1 mm large, widely obovate, obovate to widely oval. Apex with a conical tip, base narrowed into a slender neck with protuberances of 4 to 3 radii from the broken-off basal collar. The endocarp is convexly broadened into 3 to 4 lobes, among which longitudinal shallow grooves are visible. Surface dull, shagrenate.

Remarks. The available specimens differ from *C. reidiorum* NIKITIN in shorter and more robust shape. *C. oligovasculare* MAI (in Knobloch 1978) has ovate endocarps of larger size with somewhat a wider neck and 3-5 deep longitudinal grooves. *C. crassum* NEGRU (1972) is larger, has robust basal protuberances and is trilobate with fine ribs on longitudinal grooves. The most similar in shape appears to be *C. palaeomariscus* DOROFEEV (1969) and the material from Stare Gliwice (Szafer 1961), but our specimens differ in having a slender neck.

Occurrence. Cheb Basin - core HP 12 P, 68 m; Sokolov Basin - Jiří Mine (erosion filling in the Antonín Seam).

Cladiocarya chomutovensis (BŮŽEK et HOLÝ) BŮŽEK et HOLÝ comb. n.

Pl. 31, fig. 7

1964 *Sparganium chomutovense* sp. n.; Bůžek and Holý, p. 127, pl. 8, figs 5-9, textfigs 2/7 a-b (basionym).

Description. The endocarps identical with those described by Bůžek - Holý (1964).

Remarks. For several reasons (e.g. bisymmetry of endocarps) the transfer of this species to *Caricoidea jugata* (NIKITIN) MAI (in Mai and Walther 1978) is in our opinion incorrect.

Occurrence. Sokolov Basin - Jiří Mine (erosion filling in the Antonín Seam).

Cladiocarya trebovensis (BŮŽEK) MAI

Pl. 30, figs 5-6

1963 *Sparganium trebovense* sp. n.; Bůžek, p. 126, pls 11-13.
1978 *Cladiocarya trebovensis* (BŮŽEK) MAI comb. nov.; Mai and Walther, p. 144, pl. 1, fig. 9, pl. 48, figs 39-41.
1978 *Cladiocarya trebovensis* (BŮŽEK) MAI, comb. n.; Knobloch, p. 159.

Description. The recovered endocarps correspond exactly with the description given by Bůžek (1963).

Remarks. Sometimes the exocarp also remains preserved. For discussion see below.

Occurrence. Cheb Basin - cores HV 1, 147-148 m, HV 2, 112.4 m, 130 m, HV 14, 227-228 m, HV 18, 26-28 m, 53-54 m, 75-76 m, V 1, 76-77 m, V 5 38-39 m, V 9, 72-73 m, V 14, 22-23 m, D 11, 16.2-16.3 m, A 2, 85 m; Sokolov Basin - Dukla Mine, Medard Mine (erosion filling in the Antonín Seam).

Cladiocarya cf. *lusatica* MAI

Pl. 31, fig. 8

? 1978 *Cladiocarya lusatica* MAI sp. n.; Knobloch, p. 159, pl. 1, figs 4-7.

Description. A large endocarp transversally oval, 2 mm long and 2.2 mm wide matches in size the holotype of *C. lusatica* and in form the material from the Lower Miocene of S. Moravia (Knobloch 1978).

Remarks. This species occurs solitarily in the Cheb Basin.

Occurrence. Cheb Basin, core V 3a, 31-32 m.

Cladiocarya sp.

Pl. 30, figs 1-4, 7-12

Description. Fruits mostly secondarily compressed, flat, rarely preserved in groups of 2 or 3, sessile, on a common axis (? or tissue), otherwise mostly individual, pear-shaped, with elongate apex, rarely with the remainder of style up to 2 mm long, and rounded, mostly blunt to truncate at base, sometimes with a distinct, often obliquely orientated, very short stalk. Length c. 3-4 mm, width 1.8-2 mm., the maximum width approximately in the lower third. Exocarp obviously not thick, rather thinner coriaceous, probably dry. Apical part formed only by the network of exocarp. Seen in impressions, it is always flat, contrary to the remaining part, which is filled with the endocarp and is convex over the bedding plane. Exocarp distinctly differentiated from the endocarp. Because of different texture of both layers, they can be easily separated from each other, when specimens dried up. Therefore it was possible to separate the endocarps from the fruits, which remained firmly imbedded in the matrix by the exocarp. Exocarp surface finely verrucate to wrinkled, with fine, longitudinal sculpture of small elongate meshes.

Remarks. Only complete specimens of the fruits afford information as to the character of the exocarp (Mai in Mai and Walther 1978). The exocarp is usually not preserved in the material separated by washing. This was also the reason, why the endocarps from the Badenian near Česká Třebová were misinterpreted as *Sparganium* L. (Bůžek 1963).

3-4 types of endocarps can be recognized in the Cypris Shale, all bearing the same type of exocarp and belonging to *Cladiocarya* E. M. REID et CHANDLER. The exocarp structure corresponds most closely to that of *C. europaea* MAI (see Mai in Mai and Walther 1978, 1991). The exocarp of *C. trebovense* in Mai's opinion should have been thin and shortly conical. (In our material such a case does occur). In other specimens with comparable endocarps the exocarp is thicker, longly conical, with elongate distal part, as in *C. europaea*. It is obvious that the differences in exocarp character are not always diagnostic at the species level and may vary. Therefore the recovered material is provisionally assigned to *Cladiocarya* sp. The discrimination of species on the basis of endocarps is somewhat formal in view of transitional forms (cf. *C. lusatica* MAI in Knobloch, 1978, pl.1, fig. 4 and *C. europaea* MAI in Mai and Walther, 1978, pl. 48, fig. 38). The whole group deserves a special monograph. This was intended by Bůžek, who was, unfortunately, unable to finish it.

Occurrence. Cheb Basin - most cores studied, Pochlovice, Kaceřov, Kynšperk; Sokolov Basin - cores 15 H, 89-90 m, 126-127 m, 29 P, 12-13 m, 27-28 m, Dukla Mine.

Ruppiaceae

Limnocarpus longipetiolatus (ENGELHARDT) BŮŽEK et HOLÝ

Pl. 31, fig. 3

1880 *Carpolithes longepetiolatus* nov. sp.; Engelhardt, p. 19, pl.9, fig. 15.
1981 *Limnocarpus longepetiolatus* (ENGELHARDT) comb. nov.; Bůžek and Holý, p. 164, pl. 1, pl. 2, figs 1-10, pl. 3, text-figs 1-2.

Description. Abundant remains of endocarps. Inner structure well preserved.

Remarks. The species was described in a separate detailed study (Bůžek and Holý 1981).

Occurrence. Cheb Basin - majority of cores studied, Mokřina, Kynšperk, Pochlovice; Sokolov Basin - core 25 H, (?) 47-48 m, Dukla, Jiří Mines.

Limnocarpus medardii BŮŽEK et HOLÝ

1981 *Limnocarpus medardii* sp. nov.; Bůžek and Holý, p. 167, pl. 2, figs 11-12, pl. 4, text-figs 1-2.

Remarks. Except for a single specimen from the lignite clay facies (core HV 11, 83 m) all other material is confined to the Cypris Shale facies. For details see the monograph (Bůžek and Holý 1981).

Occurrence. Cheb Basin - cores HV 2, 134.5 m, HV 8, 131-132 m, HV 11, 83 m, HV 12, 106 m, 111 m, HP 3 P, 41 m, V 1, 54-55 m; Sokolov Basin - core 25 H, 56-57 m, Dukla, Družba and Medard Mines, Medard Mine (erosion filling in the Antonín Seam).

Potamogetonaceae

Potamogeton sp.

Pl. 31, fig. 5

Description. A single endocarp 1.7 mm long and 1.15 mm wide, slightly oblique, obovate in outline. Dorsal side convex, vetral side almost straight. Apex rounded, style lacking. Base moderately narrowed, rounded. Side pit (without perforation) oval, 0.25-0.3 × 0.2 mm in size, centrally situated. Germinal lid broad, reaching to the apex, with blunt edge. Surface (? exocarp) covered on sides by a net of rounded pits that become elongate and transfer into parallel shallow and fine striae along the lid. The same, but still finer striation along the ventral margin.

Remarks. The only record of *Potamogeton* L. in the Cypris Shale is dificult to identify with any of the fossil species which have been described. The form is quite characteristic but more material is needed.

Occurrence. Sokolov Basin - Medard Mine (erosion filling in the Antonín Seam).

Glumophyllum sp. 1

Pl. 32, fig. 5

Description. A small fragment of a ribbon-shaped leaf with parallel longitudinal venation. Veins less than 1 mm apart. Epidermis composed of longitudinally elongated cells with slightly undulate anticlines. Stomata c. 18 µm long, oval, obliquely orientated, arrangement of subsidiary cells uncertain.

Remarks. Weyland (1957) described similar dispersed cuticles from the Main Seam in Rhineland as *G. tenellum* WEYLAND, which differ from our material in larger stomata. Almost identical cuticular structures are illustrated by Litke (1966) as *Glumophyllum* sp. 1 from the Second Seam of Lusatia. A more detailed systematic position has not been ascertained.

Occurrence. Cheb Basin - core HV 16, 43-44 m.

Glumophyllum sp. 2

Pl. 32, fig. 4

Description. A fragment of ribbon-shaped leaf, c. 10 mm wide, with preserved carbonized matter, without distinct venation. Epidermis composed of elongate rectangular cells with straight anticlines. Among them rows of widely spaced stomata (between two veins c. 4 rows 50 µm apart). Stomata oval, c. 30 µm long showing wide, spindle-shaped outer cavity.

Remarks. Similar dispersed cuticles are known from the Second Lusatian Seam as NFu 7 sensu Litke (1966). Litke considers this type of remains to belong to Cyperaceae. More precise determination is impossible due to poor and scanty material.

Occurrence. Cheb Basin - core HV 1, 151-152 m.

Monocotyledonae gen. et sp. div.

Pl. 32, fig. 6

Remarks. Various leaf remains of obviously monocot plats, most of which are morphologically poorly preserved and almost undeterminable, occur at several levels of the Cypris Shale. They suggest that monocots must have been well represented in this flora, although no information on generic composition can be obtained.

Occurrence. Cheb Basin - cores HV 1, 129.2-129.3 m, 134.5 m, 140-141 m, 151-153 m, 158.6 m, 167-168 m, 170-717 m, HV 2, 112.4 m, 119.5 m, 126-127.5 m, HV 6, 91-92 m, 106-109 m, 117-118 m, HV 7, 87-88 m, HV 9, 109-110 m, 114-115 m, HV 11, 30-31 m, 38-39 m, 81-82 m, 85-86 m, 88-89 m, HV 12, 89-90 m, HV 13, 154-155 m, HV 16, 43-44 m, HV 17, 86-87 m, HV 18, 48-49 m, V 3a, 42-43 m, V 9, 88.4 m, D 7, 24.1 m, A 42, 18-19 m, Pochlovice, Kaceřov; Sokolov Basin - Dukla, Družba, Jiří, Medard Mines.

Incertae sedis

Hartziella* cf. *rosenkjaeri (HARTZ) SZAFER

Pl. 13, fig. 6

1909 *Carpolithes rosenkjaeri*; Hartz, pp. 123, 279, pl. 4, figs 11-15.
1963 *Hartziella rosenkjaeri* (HARTZ) comb.n.; Szafer, p. 27.

Description. Secondarily very flattened trilocular fruits of rounded outline, with slightly arched individual locules, 1.5-2.1 mm long and 1.5-1.8 mm wide. Apex and base with a small central pit. Central canal visible. Germinal lid widely elliptical. Surface covered with a fine net of rounded pits (epicarp probably removed during transport). The pitting on the lid seems to be coarser than on the remaing surface of the fruits (c. 0.02-0.03 mm across).

Remarks. The systematic position of these fruits was studied by Szafer (1963). Their stratigraphical and geographical distribution is very interesting. The species occurs in the Upper

Oligocene of Siberia (Dorofeev 1963) and is also associated with the Miocene carpological taphocenoses there. In Europe, it starts to appear in the Badenian and commonly in the Pliocene. Knobloch (1978) recorded it in the Miocene of southern Moravia. Szafer (1961) admits the occurrence of this species not only in fresh-water facies, but also in brackish or even marine deposits.

Occurrence. Sokolov Basin - Medard Mine (erosion filling in the Antonín Seam).

Carpolithes sp. 1

Pl. 10, figs 6-8

Description. Probably a dehiscent fruit valve of ovate outline, with the remains or impression of a seed in the middle of the same shape. Medial part (with the seed) finely ribbed, the fruit margin more tough (probably wingless), with inconspicuous radial veins and perhaps one concentric vein. The inner (seed) part connected with the margin by a thin canal.

Remarks. Systematic relations of the remains not known.

Occurrence. Cheb Basin - cores HV 8, 115-116 m, HV 9, 108-109 m.

Carpolithes sp. 2

Pl. 27, fig. 8

Description. Winged body with strikingly dark proximal (probably seed) part. Wing one-sided, with a very fine structure in the form of rectangular meshes, longitudinally orientated and parallel from the proximal to the distal part.

Remarks. Winged body may represent a part of a schizocarpic fruit or a complete fruit. No modern affinities can be suggested at the moment.

Occurrence. Sokolov Basin - Dukla Mine.

cf. ***"Viburnum" atlanticum*** ETTINGSHAUSEN

Pl. 24, figs 10-11

? 1868 *Viburnum atlanticum* ETTINGSH.; Ettingshausen, p. 209, pl. 36, fig. 2.

Description. Leaves with a cuneate base, rather asymmetric, coarsely and shallowly serrate. Venation semicraspedodrome, secondaries very thin, rather steep, irregular, forked at the margin, looping, side veins entering the sinuses.

Remarks. These forms resemble the leaves assigned to *Viburnum atlanticum* from the České Středohoří Volcanic Complex and the deposits of the North Bohemian Basin. Their identity cannot be warranted in view of the absence of epidermal structures.

Occurrence. Cheb Basin - cores HV 2, 129.4 m, HV 4, 88-89 m, HV 11, 88-89 m, HV 18, 32-33 m.

Dicotylophyllum sp. 1

Pl. 29, figs 1-4

Description. A leaf obovate, with cuneate base, suddenly narrowed towards the apex (apex proper lacking), c. 95 mm long and 45 mm wide, the maximum width in the upper part. Margin with very distinct marginal ridges of fimbrial origin (sometimes tearing off from the blade), and with shallow rounded incissions except for the entire-margined base. Secondaries at angles 30-45°, rather straight, dense, 10-12 on each side of the midvein, ending in the marginal incissions. Intersecondaries thinner and not reaching the margin. Tertiary venation irregular, transversally to exmedially branched, very fine, almost not discernible. Black traces of elongate to drop-like shape irregularly distributed on the blade surface, partly fringing the margin (? oil cells). Petiole short, thick. Texture perhaps not too firm.

Remarks. Such interesting leaf morphology has not been encountered in any fossil material and we do not know of any modern plant bearing such foliage. To a certain extent it resembles *Didymeles excelsa* BAILL. (see Wolfe 1973) but differs in denser and straighter secondaries with marginal incisions. However, it matches in exmedial tertiary venation and the presence of a marginal vein and ridge. Similar marginal veins or ridges also occur in Menispermaceae and Sabiaceae (Hickey and Wolfe 1975). Thymeleaceae form mostly the intramarginal vein (Wolfe 1973). A closer relationship to *Didymeles excelsa* is less probable in view of the endemic occurrence of this species on Madagascar. The affinities of this single impression must therefore remain open.

Occurrence. Sokolov Basin - Dukla Mine.

Dicotylophyllum sp. 2

Pl. 27, fig. 11

Description. A leaf alongate, entire-margined, about 10 mm long, obviously coriaceous, without clearly visible details of venation.

Remarks. Similar foliage occurs in the Ericaceae. Without anatomical evidence, such leaf forms are not identifiable.

Occurrence. Sokolov Basin - Dukla Mine.

Dicotylophyllum sp. 3

Pl. 27, fig. 7

Description. A small entire-margined leaf, rather well preserved, but of uncertain systematic position.

Occurrence. Sokolov Basin - Dukla Mine.

fructification incertae sedis

Pl. 31, fig. 4

Description. A part of a rather large, branched and obviously pendulous infructescence with attached globular, almost sessile or shortly stalked fruits (? berries) on a thicker main axis and lateral branches. Fruits c. 1.5-3 mm in diameter, traces of endocarps or seeds not observed. Some ? berries showing a small distal protuberance.

Remarks. No modern relations can be suggested at present.

Occurrence. Cheb Basin - core HV 12, depth not indicated.

Taphonomy and palaeoecology

A sedimentary environment influences the composition of plant taphocenoses and can provide clues for vegetational reconstructions of the plant fossil record. Roth and Dilcher (1978) studied the differenciation of leaf remains in Recent deposits of a lake near Bloomington, which may serve as a model for the conditions in the Cypris Shale drainless basin. The further from banks the samples were taken, the fewer species growing around the lake were represented. Small, coriaceous leaves withstand longer transport and are overrepresented, while (possibly underrepresented) herbaceous foliage decays. Calm waters of the shallow Cypris Lake did not carry plant remains in large quantity. Hence determinable leaf fossils are solitarily deposited and fossilized. They are confined to particular horizons of well bedded claystone. Wind transport must have played an important role as those fruits and seeds adapted to aerial transport prevail. Only remains of autochthonous plants - Characeae, *Riccia*, *Limnocarpus* occur in larger quantities on bedding planes.

As stated in the lithological descriptions (p. 2-3) the transition from the coal-forming swamp environment towards the drainless lake was at some places gradual. The period is reflected in coal and mica clay wedged between the Main Seam and the Cypris Shale facies in the western part of the Cheb Basin. Similarly, erosion fillings in the roof of the Antonín Seam (Medard and Jiří Mines in the Sokolov Basin) contain assemblages that indicate the extinction of coal-forming swamps. They mainly preserve water and riparian plants, such as *Aldrovanda*, *Cladiocarya*, *Potamogeton*, *Hartziella*, *Limnocarpus* in addition to woody plants that were part of the swamp forests -

Glyptostrobus, *Magnolia*, *Nyssa*, *Meliosma*, and also *Pinus* in the Cheb Basin. Lignite clay facies is richer in some broad-leaved trees - *Alnus*, *Acer tricuspidatum*, *Quercus rhenana*, "*Viburnum*" *atlanticum*, which attest to a change from the coal-forming swamp forest to a flooded riparian forest. Contrary to similar but mostly deciduous forests (with *Taxodium*, *Ulmus*, *Populus*, *Salix*) in the North Bohemian Basin, those in the Cheb Basin are richer in palaeosubtropical elements - Lauraceae, *Magnolia*, *Symplocos*, *Engelhardia*, *Tetraclinis*. A large variety of shrubs (*Myrica*, *Comptonia*, *Toddalia*) and water and marsh herbs (*Riccia*, *Salvinia*, *Osmunda*, *Cladiocarya*) suggest that the forests were discontinuous, being interspaced by marshes.

The typical Cypris Shale clearly differs from the coal clay facies by its plant content. Only a very small share of swamp elements survived. Plant remains are concentrated in some levels that correspond with the increasing movement of waters. As stated above, these are in the lower part of the sequence in the Cheb Basin and in the upper part in the Sokolov Basin, mainly in its western part. According to the composition, these taphocenoses reflect forest vegetation covering stream levees and wider uplands around the lake. Mesophytic elements generally dominate. In addition to allochthonous remains, water vegetation is also evidence of a change in the water regime. In waters in which salinity and nutrients periodically increased, a specific community of *Limnocarpus* and *Cladiocarya* thrived. *Limnocarpus* fruits appear in large quantities on some bedding planes (e.g. between Kopanina and Nová Ves). *Riccia* may also appear in other levels. We expect that the soils on the lake border were inhabited by this specific vegetation, which tolerated the higher salt content. Otherwise the forests avoided these habitats.

As a whole, the taphocenoses of the typical Cypris Shale of the Cheb Basin are characterized by dominating *Pinus*, *Laurophyllum pseudoprinceps*, *Daphnogene polymorpha*, *Engelhardia*, *Acer* and *Podocarpium*, with accessory *Myrica*, *Trigonobalanopsis*, *Quercus kubinyii*, *Q.* cf. *drymeja*, *Platanus neptuni*, *Distylium fergusonii*, *Laurophyllum* sp. div., *Zelkova* and *Ailanthus*. Among the conifers *Pinus* prevails over other genera. A similar composition is found in the Sokolov Basin, but is less diversified. Evergreen and thermophilous elements, particularly Lauraceae, are always common.

The remains of deciduous trees (Arcto-Tertiary elements) are rare, particularly leaves or massive fruits (stones), carried by animals. On the other hand, winged fruits were certainly blown on the water plane by wind and are quite common (*Acer*, *Engelhardia*). Therefore the reconstructions of vegetation seem to be more appropriately based on the presence or absence of elements. Vegetational transects and succession data were compiled in the form of schematic diagrams (Bůžek et al. 1987).

Progressing taxonomic research of the European Tertiary floras reveals various indigenous elements that have survived to the present, mainly in East Asia and Central or Atlantic North America and elsewhere, or became extinct. These phytogeographic elements can also be recognized in the Cypris Shale flora. The following grouping is suggested:

A. evergreen or thermophile (palaeosubtropical) elements:
  A. 1. related to Macaronesia:
    Laurus abchasica
    Ocotea hradekensis (possibly)
    Hedera sp.
    Smilax sagittifera
  A. 2. related to East Asia:
    Mastixia amygdaliformis
    Platanus neptuni
    Distylium fergusonii
    Buxus egeriana
    Magnolia burseracea/kristinae
    cf. *Cayratia* sp.
    Tetrastigma sp.
    Symplocos sp. div.
    Toddalia maii
    Meliosma pliocenica
    Sinojackia sp.
    Ternstroemia sequoioides

    - *Gordonia hradekensis*
  - A. 3. related to both East Asia and Central America:
    - *Engelhardia macroptera/orsbergensis*
  - A. 4. extinct or uncertain:
    - *Trigonobalanopsis exacantha/rhamnoides*
    - *Laurophyllum* sp. div.
    - *Daphnogene polymorpha*
- B. deciduous woody plants (Arcto-Tertiary element):
  - B. 1. related to East Asia:
    - *Cyclocarya nucifera*
    - *Alnus gaudinii*
    - *Cercidiphyllum crenatum*
    - *Schisandra* sp.
    - *Quercus kubinyii* (possibly)
    - *Quercus* cf. *drymeja*
    - *Cragia bronnii*
    - *Ailanthus confucii*
    - aff. *Sapindus falcifolius*
  - B. 2. related to both southern Europe/Asia Minor and East Asia
    - cf. *Pterocarya* sp.
    - *Zelkova zelkovifolia*
    - *Acer* cf. *pseudomonspessulanum* (possibly)
    - *Ziziphus paradisiaca*
    - *Prunus* sp.
  - B. 3. related to both North America and Asia Minor:
    - *Liquidambar europaea*
  - B. 4. related to North America (partly also to East Asia):
    - *Carya* sp.
    - *Myrica* cf. *minima/lignitum*
    - *Comptonia srodoniowae/acutiloba*
    - *Acer* sp. div.
    - cf. *Sassafras* sp.
    - *Ampelopsis* cf. *rotundatoides*
    - *Parthenocissus* sp.
    - *Zanthoxylum* cf. *ailanthiforme*
  - B. 5. panholarctic:
    - *Fraxinus* sp.
    - *Betula* sp.
    - *Ulmus* sp.
    - *Populus populina*
    - *Tilia* sp.
    - *Swida buglowiana*
  - B. 6. extinct:
    - *Podocarpium podocarpum*

In the Cypris Shale flora Arcto-Tertiary elements slightly prevail over the palaeosubtropical. Subxerophytic plants are rare, possibly *Quercus* cf. *drymeja* and *Podocarpium*. Untypical drip-tips on leaves of *Laurophyllum* sp. div. and *Trigonobalanopsis* suggest rather a monsoon type of precipitation regime. The portion of entire-margined (40%) versus dentate (60%) leaf forms/species together with the floristic composition indicate that the mesophytic forests of the Cypris Shale correspond best with the ecotonal zone between the Notophyllous Evergeen Broad-leaved and Mixed Mesophytic Forests sensu Wolfe (1979) within humid to semihumid subtropical climates. Pine forests formed considerable patches around the lake. As stated above, the forests inhabited mesic habitats on slightly raised positions while a broader strip of salty soils around the lake was treeless, with only herbaceous cover of facultative halophytes. This can be also assumed from the fact that even drifted variegated sandy facies is extremely poor in plant fossils (*Celtis lacunosa*, *Limnocarpus*). In clay interbeds between sandy layers the same type of taphocenses as in the Cypris Shale was described (e.g. cores V 5 - *Pinus* sp., *Laurophyllum pseudoprinceps*, *Cladiocarya* sp., V 3a - *Pinus* sp., *Daphnogene polymorpha*, V 10 - *Laurophyllum nechranicense*). Diversified palaecarpological taphocenoses of younger mastixioid floras known in Central Europe (e.g. Wiesa) are missing in these deposits. Only in the sandy lignites at Františkovy Lázně (Haidinger 1839, Kirchheimer 1939, Holý 1977a), which preceded the deposition of the Cypris Claystone, do richer mastixioid assemblages occur. Similarly, the flora from core V 146 outside the Cheb Basin is much richer. It shares some elements in common with the Cypris Shale flora (e.g. *Magnolia burseracea*, *Trigonobalanopsis*, *Sinojackia*, *Platanus neptuni* etc.) but also contains others (*Cunninghamia*, *Torreya*, *Taxus*). We hesitate to include these floras in the Cypris Shale unit.

The following palaeoclimatic conditions can be expected during the deposition of the Cypris Shale complex: At least 800 mm total annual precipitations, probably variable in various seasons, equable temperature regime with the mean annual temperature about 15° C and the mean annual range not more than 25° C, very occasional frosts, and the January mean over zero.

Age and comparisons with other Miocene floras

The direct dating of the Cypris Shale is possible only in the Cheb Basin. In the lignite clay and overlying variegated facies at Dolnice, mammal faunas in close succession indicate the zone MN 4 a-b, i.e. the Ottnangian age (Fejfar 1974). Higher levels of the Cypris Shale are dated by the mammal fauna of Františkovy Lázně (foundations of the school building), which corresponds with the zone MN 5, i.e. the Karpathian (Fejfar 1974, 1975).

The palaeocarpological assemblages of the flora itself include a number of "younger" elements. Therefore Mai (1964) compared it with his zones X or XII and also Holý (1977b) speculated a Badenian or Karpathian age. On the other hand, the leaf assemblage shows more ancient character. Younger Badenian - Sarmatian elements, such as *Platanus leucophylla*, *Acer aegopodifolium*, *Quercus pseudocastanea*, are not represented, but instead some Palaeogene lineages persist - *Platanus neptuni*, *Laurophyllum medimontanum*, *Laurophyllum markvarticense*. In this respect, the dating using mammals does not contradict the floristic development in the Cheb and Sokolov Basin. The Cypris Shale flora seems to be younger than that of Wiesa or Hrádek n. N. (zone VI) and may occur in zones VII or VIII near and in the Second Lusatian Seam. More common links connect this flora with Wackersdorf (Gregor 1978 a, b, 1979) and Fasterholt (Friis 1985). Newly revised floras of the Mydlovary Formation in South Bohemia (Knobloch and Kvaček in press) seem to be correlatable at least with the uppermost levels of the Cypris Shale in the Cheb Basin. Correlation problems were more broadly discussed by Bůžek et al. (1988).

Regional stratigraphers (see e.g. Svoboda et al. 1961) used to correlate the Main Seam and its overlying strata of the North Bohemian Basin with the Main/Antonín Seam and the Cypris Shale of the Cheb and Sokolov Basins. This assumption is hardly tenable. The floras of the North Bohemian Basin are quite different and occur by its middle part, i.e. Main Seam strata, into zone IV (sensu Mai 1966). The mastixioid assemblage is not developed, and the flora includes a prevailing share of Arcto-Tertiary elements. Its age is Eggenburgian according to the mammal faunas of the zone MN 3 a. Only the highest positions of the North Bohemian Basin near Lom yielded a flora similar in some extent to that of the Cypris Shale (Bůžek et al. 1988).

Ranně miocénní flóra cyprisových břidlic (západní Čechy)

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Nadloží sloje Antonín sokolovské pánve a hlavní sloje chebské pánve tvoří cyprisové břidlice - pevné jílovce obsahující bituménní látky. Z nich jsou známé výskyty fosilních zbytků rostlin i živočichů (skořepatců, hmyzu, nižších i vyšších obratlovců). V této práci jsou shrnuty dosavadní znalosti o makroflóře (viz též výzkumná zpráva Bůžek et al. 1980). Studie mastixiové flóry od Františkových Lázní a některých nových nálezů z periferie chebské pánve (vrt V 146, Plesná) nejsou včleněny, neboť pozice těchto nálezů vůči sloji zůstává nejasná.

V seznamu druhů (tab. 1) převažují mezi cévnatými rostlinami krytosemenné (106 druhů) nad nahosemennými (11) a kapraďorosty (5 druhů). Charakteristickými složkami allochtonní vegetace jsou borovice a teplomilné elementy (*Tetraclinis*, *Magnolia*, *Engelhardia*, *Myrica*, *Platanus*, *Trigonobalanopsis*, Lauraceae, *Podocarpium*, *Buxus*). Z opadavých listnáčů jsou významněji zastoupeny *Acer* sp. div. a *Quercus kubinyii*. Autochtonní vegetaci jezera tvoří *"Chara"*, *Riccia*, Cyperaceae, *Limnocarpus*. Poslední složka svědčí o zvýšených obsazích solí v některých etapách pánevní sedimentace. Zvláštní facie uhelných jílů (na Chebsku) a výplně erozivních rýh v hlavě sloje (na Sokolovsku) obsahuje flóru obohacenou vlhkomilnými prvky (*Glyptostrobus*, *Comptonia*, *Myrica*, *Alnus*, *Nyssa*, *Decodon*). Zachycuje změnu uhlotvorné vegetace v příbřežní a mokřadní porosty. Vzácné nálezy některých plodů a semen (*Symplocos*, *Ternstroemia*, *Sinojackia*, *Ailanthus*, *Meliosma*, *Mastixia*, Vitaceae) podtrhují teplomilný charakter flory. Některé další elementy (*Quercus* cf. *drymeja*, *Podocarpium*) prozrazují subhumidní ráz klimatu s určitou periodou sucha.

Vegetace odpovídá širšímu přechodu mezi dubo-vavřínovými stálezelenými lesy a smíšenými listnatými mezofytními lesy dnešní východní Asie. Stratigraficky spadá spodní část cyprisových břidlic, odkud pochází převážná část rostlinných fosílií, do savčí zóny MN 4a, b. Vyšší polohy význačné převahou *Pinus hepios*, přecházejí do zóny MN 5. Vrstevní sled je možné korelovat se stupni ottnang až karpat ve smyslu regionální chronostratigrafické škály paratethydy, to jest s vyšším spodním miocénem.

Flóru cyprisových břidlic lze nejlépe srovnávat s flórou od Wackersdorfu v Německu. Pouze nejvyšší polohy nadloží mostecké pánve v blízkosti lomské sloje poskytly obdobná společenstva rostlin. Vcelku je však flóra spodní a střední části mosteckého souvrství odlišná a je datovaná savčí faunou při bazi hlavní sloje (zóna MN 3) do eggenburgu.

Table 1

Cypris Shale flora and comparisons with related floristic complexes

1: Cheb Basin, shale facies, 2: Cheb Basin, coaly facies, 3: Sokolov Basin, shale facies, 4: Sokolov Basin, erosion fillings, 5: North Bohemian Basin, Most Formation (according to Kvaček and Bůžek 1983), 6: Wackersdorf (according to Gregor 1989), 7: Souht Bohemian Basins, Mydlovary Formation (according to Knobloch and Kvaček in press) (. single specimen, + 2-9 specimens, ! 10 and more specimens, × identical or closely related taxon, - absent)

taxon	1	2	3	4	5	6	7
"Chara" neogenica	+	-	+	-	-	-	-
Roselinites areolatus	.	-	-	-	×	×	-
Mycophyta gen. et sp. div.	!	-	+	-	×	×	×
Riccia cf. *fluitans*	!	-	!	-	-	-	-
Osmunda sp.	-	.	-	-	×	-	×
Lygodium gaudinii	+	-	-	-	×	×	-
Salvinia sp.	.	+	-	-	×	×	×
Pronephrium styriacum	.	-	-	-	×	×	×
Polypodiaceae gen. et sp.	+	-	-	-	-	-	-
Pinus hepios	!	-	+	-	×	×	×
Pinus rigios	!	+	!	-	×	-	×
Pinus cf. *saturni*	!	-	-	-	-	-	-
Pinus sp. div. (foliage)	!	!	!	-	-	-	-
Pinus sp. div. (male cones)	!	!	!	-	×	×	×
Pinus sp. div. (seeds)	!	+	!	-	×	×	×
Pinus sp. div. (female cones)	!	+	!	-	×	×	×
cf. *Cathaya roseltii*	.	-	-	-	-	-	-
Glyptostrobus europaeus	+	!	-	.	×	×	×
Tetraclinis salicornioides	!	+	-	-	×	×	-
? *Chamaecyparis* sp.	.	-	-	-	-	-	-
Magnolia burseraceae	!	+	+	+	×	×	-
Magnolia kristinae	!	-	-	-	-	×	-
Nymphaea szaferi	.	-	-	-	-	-	-
Nymphaeaceae gen. et sp.	.	-	-	-	-	×	×
Schisandra sp.	+	-	-	-	-	-	-
Cerdiphyllum crenatum	.	-	-	-	×	-	-
Myrica lignitum	!	!	-	-	×	×	×
Myrica vindobonensis	-	-	.	-	-	-	-
Myrica cf. *minima*	+	.	-	-	×	×	×
Comptonia acutiloba	-	!	-	-	×	-	×
Comptonia srodoniowae	-	!	-	-	×	-	-
Comptonia cf *srodoniowae*	-	!	-	-	×	-	-
cf. *Pterocarya* sp.	-	-	.	-	×	×	-
Cyclocyrya nucifera	.	-	-	-	-	-	-
Engelhardia orsbergensis	!	-	+	-	×	×	×
Engelhardia macroptera	!	-	!	-	×	×	×
Carya sp.	+	-	-	-	×	×	×
Betula sp. (foliage)	.	-	.	-	×	×	×
Betula sp. (fruits)	+	-	.	-	-	-	-
Alnus gaudinii	+	+	+	-	×	×	-
Alnus cf. *julianiformis*	-	!	-	-	×	×	×
Alnus sp. (infructescences)	.	.	-	-	×	×	-
Quercus kubinyii	!	-	-	-	×	×	×
Quercus rhenana	-	.	-	-	×	×	-
Quercus cf. *drymeja*	+	-	-	-	×	×	×
Trigonobalanopsis rhamnoides	!	+	!	-	×	×	×
Trigonobalanopsis exacantha	+	-	-	-	-	×	-
Distylium fergusonii	+	-	-	-	-	×	-
Liquidambar europaea	+	-	-	-	×	×	×
cf. *Liquidambar* sp.	+	-	-	-	×	×	-
Platanas neptuni	!	!	!	-	×	-	-
Ulmus sp.	+	.	+	-	×	-	×
Zelkova zelkovifolia	!	.	!	-	×	×	×
Celtis cf. *lacunosa*	!	-	-	-	×	-	-
Cedrelospermum leptospermum	-	-	+	-	×	-	-
Ocotea hradekensis	!	.	-	-	-	×	×

taxon	1	2	3	4	5	6	7
cf. *Sassafras* sp.	+	-	-	-	-	-	-
Laurus abchasica	+	-	-	-	×	×	×
Laurophyllum markvarticense	+	-	-	-	-	-	-
Laurophyllum mendimontanum	.	-	-	-	-	-	-
Laurophyllum nechranicense	!	+	+	-	×	-	-
Laurophyllum pseudoprinceps	!	!	!	-	×	×	×
Laurophyllum rugatum	+	+	-	-	-	×	×
Laurophyllum sp. div.	!	!	!	-	-	-	-
Alndrovanda intermedia	-	-	-	+	-	-	-
Prunus sp.	-	-	.	-	-	×	-
cf. *Prunus* sp.	-	.	-	-	-	-	-
Podocarpium podocarpum	!	-	+	.	×	-	-
Fabaceae gen. et sp. div.	+	-	-	-	×	-	×
Gordonia hradekensis	.	-	.	-	×	×	-
Ternstroemia sequoioides	+	-	.	-	×	×	-
Populus populina	+	-	-	-	×	×	×
Symplocos lignitarum	.	-	-	-	×	×	×
Symplocos minutula	+	-	-	-	-	-	-
Symplocos ludwigii	+	-	-	-	-	-	-
Sphenotheca cf. *incurva*	.	-	-	-	-	-	-
Sinojackia sp.	.	.	.	-	-	-	-
Tilia sp.	-	-	.	-	×	-	×
Craigia bronnii	+	-	.	-	×	×	-
Buxus egeriana	+	-	.	-	-	-	-
Toddalia maii	+	+	.	-	×	×	-
Zanthoxylum cf. *ailanthiforme*	+	-	-	-	×	×	-
Ailanthus confucii	+	-	-	-	×	-	×
Fraxinus sp.	+	-	+	-	×	×	-
Decodon globosus	-	!	-	-	×	×	-
Ziziphus paradisiaca	+	-	-	-	-	-	×
Tetrastigma sp.	-	-	.	-	-	×	-
cf. *Tetrastigma* sp.	.	-	.	-	-	-	-
cf. *Cayratia* sp.	.	-	-	-	-	-	-
Ampelopsis cf. *rotundatoides*	.	-	.	-	-	×	-
Parthenocissus sp.	+	-	-	-	×	-	-
Acer tricuspidatum	+	.	+	-	×	×	×
Acer cf. *pseudomonspessulanum*	+	-	-	-	×	-	-
Acer angustifolium	.	-	.	-	×	-	-
Acer cf. *integrilobum*	.	-	.	-	×	-	×
Acer cf. *integerrimum*	.	-	-	-	×	-	-
Acer sp. div.	!	!	!	-	×	-	-
cf. *Sapindus falcifolius*	+	-	+	-	×	-	-
Meliosma pliocenica	+	-	-	.	×	×	-
Nyssa ornithobroma	-	+	-	.	-	×	×
Mastixia amygdalaeformis	.	-	-	-	-	×	×
Swida buglowiana	.	-	-	-	-	×	×
Hedera sp.	.	-	-	-	-	-	-
Stratiotes sp.	-	+	-	-	-	-	-
Smilax sagittifera	+	-	-	-	-	-	+
Cladium sp.	-	.	-	.	-	×	-
Cladiocarya chomutovensis	-	-	-	+	×	×	-
Cladiocarya trebovensis	+	.	-	+	-	-	-
Cladiocarya cf. *lusatica*	-	.	-	-	-	×	-
Cladiocarya sp.	!	.	!	-	-	-	-
Limnocarpus longipetiolatus	!	-	!	-	-	-	-
Limnocarpus medardii	!	.	+	!	-	-	-
Potamogeton sp.	-	-	-	.	-	-	-
Glumophyllum sp. 1	.	-	-	-	-	-	-
Glumophyllum sp. 2	.	-	-	-	-	-	-
Monocotyledonae gen. et sp.	!	+	!	.	-	-	-
Hartziella cf. *rosenkjaeri*	-	-	-	+	-	-	-
Carpolithes sp. 1	+	-	-	-	-	-	-
Carpolithes sp. 2	-	-	.	-	-	-	-
cf. *"Viburnum" atlanticum*	+	.	-	-	×	-	-
Dicotylophyllum sp. 1	-	-	.	-	-	-	-
Dicotylophyllum sp. 2	-	-	.	-	-	-	-
Dicotylophyllum sp. 3	-	-	.	-	-	-	-
fructification incertae sedis	.	-	-	-	-	-	-

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EXPLANATIONS OF THE PLATES

PLATE 1

Lygodium gaudinii HEER
1. Fragment of leaf, core HV 8, 122-123 m, × 1.5.
5. Part of fertile pinna, core HV 6, 108-109 m, × 6.

Salvinia sp.
2. Leaf covered by trichomes, core HV 6, 112-113 m, × 6.

Osmunda sp.
3. Fragmentary pinna, core A 28, 91-92 m, × 4.

Pronephrium stiriacum (UNG.) KNOBLOCH et KVAČEK
4. Fragmentary pinnule, Kynšperk, × 4.

Glyptostrobus europaeus (BRONGN.) UNG.
6. Sterile twig, core HV 11, 84-85 m, × 2.
7. Seed, core HV 11, 84-85 m, × 3.
8. Seed, core D 2, 9.6-9.8 m, × 3.
9. Seed, core V 3a, 78-79 m, × 4.
10. Cone scale from abaxial side, core HV 18, 79-80 m, × 10.

Tetraclinis salicornioides (UNG.) KVAČEK
11. Twig fragment, core HV 15, 96-97 m, × 3.
12. Twig fragment, core HV 8, 129-130 m, × 2.

? *Chamaecyparis* sp.
13. Twig, core HV 3, 120-121 m, × 4.

PLATE 2

Pinus sp. div.
1,7. Female cones, Družba Mine and Dolnice, nat. size, × 1.5.
2,5. Seeds, cores HV 11, 86-87 m and HV 3, 81-82 m, × 3, × 2.
3. Male cone, core HV 3, 74-75 m, × 3.

Pinus hepios UNGER
4. Three fascicles of needle-leaves, Kaceřov, nat. size.

Pinus rigios (UNGER) ETTINGSH.
6. Fascicle of needle-leaves, core V 3a, 73-74 m, nat. size.

PLATE 3

? *Chamaecyparis* sp.
1. Cuticle fragment with stomata, core HV 3, 120-121 m, × 500.

Pinus sp.
2-3. Foliage cuticles showing stomatal rows and stomata, core HV 1, 97. 5 m, × 200, × 500.

cf. *Cathaya roseltii* SCHNEIDER
4. Fragmentary abaxial cuticle, core HV 17, 48-49 m, × 500.

Pinus rigios (UNGER) ETTINGSH.
5. Leaf compression showing stomatal rows, core V 1, 33-34 m, × 20.

PLATE 4

Magnolia burseraceae (MENZEL) MAI
1-4. Seed impressions mostly without testa remains, cores HV 2, 111-112 m, HV 5, 59-60 m, Jiří Mine, core HV 9, 82-83 m,× 4.
5-10. Seed impressions with remains of testa, cores HV 4, 68.5 m (and counterimpression), HV 13, 137-138 m, Dukla Mine, cores HV 14, 142-143 m, HV 13, 209-210 m, × 2.
11. Carbonized seed adhearing to its impresion, core HV 2, 105.5 m, × 4.
12-15. Carbonized seeds from both sides, core HV 1, 140.6 m and 136.4 m, × 8.

Nymphaea szaferi KNOBLOCH
16. Seed, core V 14, 22-23 m, × 15.

Nymphaeaceae gen. et sp.
17. Seed, core HV 12, 106 m, × 5.

Aldrovanda intermedia REID et CHANDLER
18. Seed, Jiří Mine, × 15.

PLATE 5

Myrica lignitum (UNGER) SAPORTA
1, 2. Dentate leaf forms, Kaceřov, × 3, × 1.5.
3. Detail of the counterimpression of fig. 2, Kaceřov, × 4.
11, 12. Entire-margined leaf forms, cores HV 6, 107-108 m and HV 10, 58-59 m, × 2.

Myrica vindobonensis (ETTINGSH.) HEER
4. Leaf, Dukla Mine, × 2.

Comptonia acutiloba BRONGN.
5, 6. Leaf fragments, cores D 7, 23.5 m and HV 11, 90-91 m, × 2.

Comptonia cf. *srodoniowae* FRIIS
7, 8. Endocarps, core D 2, 12.8-13 m, × 14.

Comptonia srodoniowae FRIIS
9, 10. Fruit fragment from both sides, core D 2, 13-13.5 m, × 14.

Myrica cf. *minima* NEGRU
13. Endocarp, core HV 2, 106.3 m, × 14.

Cercidiphyllum crenatum (UNGER) R. BROWN
14. Fruits, core HV 14, 221-222 m, × 2.

PLATE 6

Magnolia kristinae KNOBLOCH et KVAČEK
1. Abaxial cuticle, core HV 11, 59-60 m, × 500.
2. Abaxial cuticle, core HV 4, 61-62 m, × 500.

Myrica lignitum (UNGER) SAPORTA
3. Adaxial cuticle, core HV 2, 81.3 m, × 500.
4. Abaxial cuticle, core HV 1, 129.8 m, × 500.
6. Peltate trichome, core V 7, 80-83 m, × 500.

Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER
5. Abaxial cuticle, core HV 12, 86-87 m, × 500.

PLATE 7

Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER
1. Leaflet, core HV 5, 69-70 m, × 1.5.
2. Leaflet, core HV 4, 90-91 m, × 1.5.
3. Leaflet, core HV 6, 106-107 m, × 2.
4. Leaflet, core HV 6, 110-111 m, × 2.
5. Fragmentary leaf, core HV 4, 96.8 m, × 2.

Engelhardia macroptera (BRONGN.) UNGER
6. Winged fruit, core HV 12, 97-98 m, × 2.
7, 8. Isolated nuts, cores D 7, 24.2 m and HV 11, 61-62 m, × 10, × 3.
9. Involucrum, core 25 H, 125-126 m, × 2.

PLATE 8

Carya sp.
1-4. Leaflet with counterimpression and details of venation and margin, core HV 10, 63-64 m, × 1.5, × 4.

cf. *Prunus* sp.
5. Leaf impression, core HV 11, 86-87 m, × 1.5.

? *Carya* sp.
6. Leaflet, core H 3, 143.5 m, × 1.5.

Cyclocarya nucifera (LUDWIG) MAI
7, 8. Halved fruit strongly compressed from above, core HV 8, 131-132 m, × 5.

PLATE 9

Betula sp.
1. Leaf, core HV 9, 112-113 m, × 1.5.
2, 3. Leaf and detail of margin, Dukla Mine, × 1.5, × 3.
4, 5. Fruit and the counterimpression, core HV 8, 119-120 m, × 4.

Populus populina (BRONGN.) KNOBLOCH
6. Leaf, core HV 6, 91-92 m, × 1.5.

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK
7. Leaf, Dukla Mine, × 1.5.
Alnus cf. *julianiformis* (STERNBERG) KVAČEK et HOLÝ
8. Leaf, core V 7, 80-82 m, × 1.5 m

Alnus sp.
9. Infructescences, core HV 18, 56-57 m, × 2.

Magnolia kristinae KNOBLOCH et KVAČEK
10. Leaf fragment, core HV 1, 129.9 m, × 2.

PLATE 10

Prunus sp.
1. Endocarp, Dukla Mine, × 2.

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK
2. Leaf, Dukla Mine, nat. size.
3, 4. Unusually large leaf form and detail of margin, core HV 3, 126.8-127 m, nat. size, × 3.

Platanus neptuni (ETTINGSH.) BŮŽEK, HOLÝ et KVAČEK
5. Leaf, core HV 9, 112-113 m, × 2.

Carpolithes sp. 1
6, 7. ? Seed of uncertain affinities with the counterimpression, core HV 9, 108-109 m, × 4.
8. Similar form, core HV 8, 115-116 m, × 4.

PLATE 11

Quercus kubinyii (KOVATS ex ETTINGSHAUSEN) CZECZOTT
1. Leaf fragment, core HV 6, 105-106, × 1.5.
5. Leaf, core HV 14, 158-159 m, × 2.
6. Leaf, core HV 6, 109-110 m, × 1.5.

Quercus cf. *drymeja* UNGER
2. Leaf, core HV 6, 105-106 m, × 2.
4. Leaf, core HV 5, 41-42 m, × 2.

Trigonobalanopsis exacantha (MAI) KVAČEK et WALTHER
3. Cupule, core HV 14, 151-152 m, × 3.

PLATE 12

Quercus rhenana (KRÄUSEL et WEYLAND) KNOBLOCH et KVAČEK
1. Trichome base on the midrib, core V 3a, 78-79 m, × 500.
2. Adaxial cuticle, core V 3a, 78-79 m, × 500.
3. Abaxial cuticle. core V 3a, 78-79 m, × 500.

Quercus kubinyii (KOVATS ex ETTINGSHAUSEN) CZECZOTT
4. Abaxial cuticle, core HV 14, 172-173 m, × 500.

Trigonobalanopsis rhamnoides (ROSSMÄSSLER) KVAČEK et WALTHER
5. Abaxial cuticle of a shade leaf, core HV 6, 107-108 m, × 500.
6. Abaxial cuticle of a sun leaf, core HV 4, 95-96 m, × 500.

PLATE 13

Distylium fergusonii KNOBLOCH et KVAČEK
1, 2. Twig with two leaves and venation detail, core HV 14, 171-172 m, × 2, × 4.

cf. *Liquidambar* sp.
3. Infructescence, core HV 2, 115-116 m, × 2.

Liquidambar europaea AL. BRAUN
4, 5. Leaves, core HV 9, 105-106 m and Pochlovice, × 3.

Hartziella cf. *rosenkjaeri* (HARTZ) SZAFER
6. Fruit, Medard Mine, × 15.

PLATE 14

Distylium fergusonii KNOBLOCH et KVAČEK
1. Adaxial cuticle, core HV 14, 171-172 m, × 500.
2. Abaxial cuticle, core HV 14, 171-172 m, × 500.
3. Abaxial cuticle with a trichome base, core HV 1, 97.2 m, × 500.

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK
4. Abaxial cuticle with a peltate trichome, core V 7, 80-82 m, × 500.

Platanus neptuni (ETTINGSH.) BŮŽEK, HOLÝ et KVAČEK
5. Adaxial cuticle, core HV 2, 127 m, × 500.
6. Abaxial cuticle, core HV 2, 127 m, × 500.

PLATE 15

Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA
1. Leafy shoot, core HV 18, 48-49 m, × 1.5.
3. Fertile leafy shoot, core 29 P, 76-80 m, × 4.
4. Leaf, core HV 4, 100-101 m, × 2.
5. Leaf, Dukla Mine, × 3.

Populus populina (BRONGN.) KNOBLOCH
2. Leaf, Pochlovice (PRC), nat. size.

Cedrelospermum leptospermum (ETTINGSH.) MANCHESTER
6. Fruit, Dukla Mine, × 4.

Ulmus sp.
7. Fruit, core HV 11, 86-87 m, × 3.
8. Fruit, core HV 8, 141-142 m, × 3.
9. Fruit, Družba Mine, × 4.

PLATE 16

Ocotea hradekensis (KVAČEK et BŮŽEK) KVAČEK, comb. n.
1. Leaf, core V 9, 64-65 m, × 1.5.
2. Leaf, core V 1, 46-47 m, × 1.5

Laurophyllum rugatum KVAČEK et BŮŽEK
3. Leaf, core HV 3, 87-88 m, × 1.5.
4. Leaf, core V 14, 63-64 m, × 1.5.

cf. *Sassafras* sp.
5. Leaf fragment, core V 7, 74-75 m, × 1.5.

Laurophyllum sp.
6, 7. Leaf and its detailed venation, Dukla Mine, × 1.5, × 4.

Daphnogene polymorpha (A. BRAUN) ETTINGSHAUSEN
8. Leaf, Jednota Mine, × 2.

PLATE 17

Laurus abchasica (KOLAKOVSKIJ et SHAKRYL) FERGUSON
1. Leaf, core HV 9, 100-101 m, × 1.5.
Daphnogene polymorpha (A. BRAUN) ETTINGSH.
2. Leaf, core HV 8, 102-103 m, × 1.5.

Laurophyllum pseudoprinceps WEYLAND et KILPPER
3. Leaf, Pochlovice. × 1.5.

Laurophyllum markvarticense KVAČEK
4. Leaf, core HV 3, 112-113 m, × 1.5.

Laurophyllum nechranicense BŮŽEK et KVAČEK
5. Leaf, Dukla Mine, × 1.5.

Laurophyllum sp.
6. Dukla Mine, × 1.5.

Laurophyllum medimontanum BŮŽEK, HOLÝ et KVAČEK
7. Leaf fragment, core HV 2, 81.9 m, × 1.5.

cf. *Sassafras* sp.
8. Leaf, core HV 8, 135-136 m, × 2.

PLATE 18

Laurophyllum nechranicense BŮŽEK et KVAČEK
1, 2. Adaxial and abaxial cuticles, core HV 14, 199-200 m, × 500.

Ocotea hradekensis (KVAČEK et BŮŽEK) KVAČEK, comb. n.
3. Abaxial cuticle, core HV 16, 37-38 m, × 500.

Laurophyllum rugatum KVAČEK et BŮŽEK
4. Abaxial cuticle, core HV 2, 112-112.3 m, × 500.

Laurophyllum medimontanum BŮŽEK, HOLÝ et KVAČEK
5, 6. Adaxial and abaxial cuticles, core HV 2, 81.9 m, × 200, × 500.

PLATE 19

Laurus abchasica (KOLAKOVSKIJ et SHAKRYL) FERGUSON
1, 2. Adaxial and abaxial cuticles, core HV 1, 97.4 m, × 200, × 500.

cf. *Sassafras* sp.
3. Abaxial cuticle near the midrib, core V 7, 74-75 m, × 500.

Laurophyllum pseudoprinceps WEYLAND et KILPPER
4. Abaxial cuticle, core HV 18, 75-76 m, × 500.

Daphnogene polymorpha (A. BRAUN) ETTINGSH.
5. Abaxial cuticle, core V 4, 32-33 m, × 500.

Laurophyllum markvarticense KVAČEK
6. Abaxial cuticle, core HV 3, 112-113 m, × 500.

PLATE 20

Hedera sp.
1. Leaf, core HV 9, 107-108 m, × 2.

Symplocos lignitarum (QUENSTEDT) KIRCHHEIMER
2. Endocarp, core HV 12, 63-64 m, × 6.

Symplocos minutula (STERNBERG) KIRCHHEIMER
3. Endocarp, core HV 2, 94-95 m, × 6.

Symplocos ludwigii KIRCHHEIMER
4. Endocarp, core HV 1, 156.4 m, × 8.

Sinojackia sp.
5. Fruit, Dukla Mine, × 2.

Nyssa ornithobroma UNGER
6. Endocarp, core D 2, 13-13.5 m, × 2.

Zanthoxyllum cf. *ailanthiforme* (GREGOR) GREGOR
7. Seed, core HV 18, 49-50 m, × 12.

Tilia sp.
8. Fragmentary bract with peduncle remains, Dukla Mine, × 1.5.

Podocarpium podocarpum (A. BRAUN) HERENDEEN
9. Fragmentary leaf, core H 3, 143.5, × 1.5.
10. Leaflet, core HV 2, 127.5 m, × 2.
11. Leaflet, core HV 4, 76-77 m, × 2.
12. Fruit, core HV 8, 117-118 m, × 2.
13. Leaflet, core HV 2, 110-111 m, × 2.
14. Leaflet, core HV 2, 132.25 m, × 2.
15. Leaflet, core HV 2, 110.6 m, × 2.

Craigia bronnii (UNGER) KVAČEK, BŮŽEK et MANCHESTER
16. Fruit valve, core HV 8, 119-120 m, × 2.

PLATE 21

Fraxinus sp.
1. Fruit, Dukla Mine, × 3.
2. Fruit, core HV 14, 220-221 m, × 3.
3. Fruit, Dukla Mine, × 3.
4, 5. Leaflet and its margin, core HV 3, 119-120 m, × 1.5, × 4.

Ziziphus paradisiaca (UNGER) HEER
6. Leaf, core HV 6, 115 m, × 2.
7. Leaf fragment, core HV 18, 55-56 m, × 2.

Ailanthus confucii UNGER
8. Fruit, core HV 8, 112-113 m, × 4.
9. Fruit fragment, core HV 8, 110-111 m, × 3.

PLATE 22

Swida buglowiana NEGRU
1, 2. Endocarp from both sides, core HV 5, 58-59 m, × 15.

Meliosma pliocenica (SZAFER) GREGOR
3, 4. Endocarp form both sides, core HV 1, 96.5 m, × 5.

Mastixia amygdaliformis (SCHLOTHEIM) KIRCHHEIMER
5, 6. Endocarp from both sides, core HV 1, 146 m, × 3.5.

Decodon globosus (REID) NIKITIN
7-10. Various seed forms, Jiří Mine, × 22.

Ternstroemia sequoioides (ENGELHARDT) BŮZEK et HOLÝ, comb. n.
11. Refigured holotype, Engelhardt (1880), pl. 9, fig. 19, Královské Poříčí (MMG), × 5.
12. Seed, core HV 12, 106 m, No. G 3133, × 5.
13, 14. Seed and its counterpart, core HV 12, 106 m, Nos. G 3134-3135, × 5.

PLATE 23

cf. *Tetrastigma* sp.
1, 2. Detached leaflets of the same leaf and the counterimpression, Dukla Mine, nat. size.

cf. *Cayratia* sp.
3. Fragmentary leaf (? leaflet), core HV 4, 91-92 m, × 2.

Tetrastigma sp.
4, 5. Seed and the counterimpression, Dukla Mine, × 8.

Parthenocissus sp.
6, 7. Seed from both sides, core HV 18, 43-44 m, × 10.

PLATE 24

cf. *Tetrastigma* sp.
1-4. Fragmentary leaf with the counterimpression and details of venation, core HP 7 P, 31-32 m, × 1.5, × 4.

Ampelopsis cf. *rotundatoides* DOROFEEV
5, 6. Seed and the counterimpression, Dukla Mine, × 4.
7, 8. Seed from both sides, core HV 1, 144-145 m, × 10.

Toddalia maii GREGOR
9. Fragmentary seed, core HV 18, 30-31 m, × 12.

cf. "*Viburnum*" *atlanticum* ETTINGSH.
10. Leaf, core HV 18, 32-33 m, × 3.
11. Leaf, core HV 11, 88-89 m, × 1.5.

PLATE 25

Acer sp. (form 1)
1. Fruit half, core V 10, 57-58 m, × 3.
2. Fruit half, core HV 9, 82-83 m, × 3.
3. Fruit half, core V 5, 60-61 m, × 4.
8. Fruit half, core HV 7, 100-101 m, × 2.
9. Fruit half, Dukla Mine, × 3.
10. Fruit half, core V 10, 57-58 m, × 3.
11. Fruit half, core HV 9, 96-97 m, × 2.

Acer sp. (form 2)
4. Fruit half, Pochlovice, × 3.
5. Fruit half, Pochlovice, × 3.

Acer tricuspidatum A. BRAUN et AGASSIZ
6. Leaf, core HV 4, 96.4 m, × 1.5.

Acer sp. (form 3)
7. Fruit, Dukla Mine, × 3.

Acer sp. (form 4)
12. Fruit half, core HV 6, 103-104 m, × 1.5.

Acer cf. *integrilobum* WEBER
13. Leaf, Dukla Mine, × 1.5.

PLATE 26

Acer cf. *intregerrimum* (VIVIANI) MASSOLONGO
1. Leaf, core HV 18, 48-49 m, × 2.
Acer angustilobum HEER
2. Leaf, Pochlovice (PRC), nat. size.

Acer sp. (form 2)
3. Fruit half, Dukla Mine, × 3.
4. Fruit half, Družba Mine, × 3.
5. Fruit half, core HV 14, 225-226 m, × 3.
7. Dukla Mine, × 3.

Acer sp. (form 3)
6. Fruit half, core HV 15, 96-97 m, × 2.

Acer sp. (form 4)
8. Fruit half, Dukla Mine, × 3.

Acer cf. *pseudomonspessulanum* UNGER
9. Leaf, core HV 18, 52-53 m, × 2.

PLATE 27

cf. *"Sapindus" falcifolius* (A. BRAUN) A. BRAUN
1, 2. Leaflet and the counterimpression, Dukla Mine, × 1.5.

Schisandra sp.
3, 4. Seed from both sides, Pochlovice, × 15.
5, 6. Seed from both sides, core HV 14, 217-218 m, × 14.

Dicotylophyllum sp. 3
7. Leaf, Dukla Mine, × 4.

Carpolithes sp. 2
8. Winged fruit, Dukla Mine, × 4.

Gordonia hradekensis (KVAČEK et BŮZEK) BOZUKOV et PALAMAREV
9. Leaf, Dukla Mine, × 3.

Sphenotheca cf. *incurva* KIRCHHEIMER
10. Fruit, core HV 9, 63-64 m, × 4.

Dicotylophyllum sp. 2
11. Extremely small leaf, Dukla Mine, × 6.

PLATE 28

Buxus egeriana KVAČEK, BŮZEK et HOLÝ
1. Abaxial cuticle, core HV 14, 225-226 m, × 500.
2. Abaxial cuticle, Dukla Mine, × 500.

Gordonia hradekensis (KVAČEK et BŮZEK) BOZUKOV et PALAMAREV
3. Adaxial cuticle, Dukla Mine, × 500.
4, 5. Abaxial cuticle, Dukla Minem, × 500.

Acer tricuspidatum A. BRAUN et AGASSIZ
6. Abaxial cuticle, core HV 11, 85-86 m, × 500.

PLATE 29

Dicotylophyllum sp. 1
1-4. Leaf with the counterimpression and details of venation; a fruit of *Ulmus* sp. amidst the leaf, Dukla Mine, × 1.5, × 4.

PLATE 30

Cladiocarya sp.
1. Fruit with endocarp enclosed in a longly conical exocarp, core HV 1, 112.9 m, × 20.
2. Fruit showing outline of enclosed endocarp and the rest of style, core HV 1, 108.8 m, × 20.
3. Big fruit with a rest of endocarp and long (? complete) style, Dukla Mine, × 20.
4. Fruit with enclosed endocarp, core V 9, 70-71 m, × 10.
7. Fruit with enclosed endocarp, core V 9, 70-71 m, × 10.
8. Fruit with uncovered smooth endocarp, Dukla Mine, × 10.
9. A group of three fruits on a common tissue fragment, core V 10, 52-53 m, × 10.
10. Two fruits joined at the base, core HV 15, 101-102 m, × 10.
11, 12. Impression and counterimpression of slightly detached two fruits, remains of endocarps oxidized, Dukla Mine, × 6.

Cladiocarya trebovensis (BŮŽEK) MAI
5. Shortly conical endocarp with a prominent ridge within the exocarp, core HV 2, 112.4 m, × 20.
6. Loose endocarp compressed from above (viewed from below), prominent ridges starting at the base well seen, core HV 14, 227-228 m, × 10.

PLATE 31

Smilax sagittifera HEER
1. Fragmentary leaf, core HV 4, 96.5 m, × 2.
2. Leaf impression with remains of carbonized lamina, core HV 1, 99-100 m, × 1.5.

Limnocarpus longipetiolatus (ENGELHARDT) BŮŽEK et HOLÝ
3. Several fruits on a bedding plane, core HV 2, 130.2 m, × 4.

fructification incertae sedis
4. Infructescence of uncertain systematic position, core HV 12, 87.8 m, × 2.

Potamogeton sp.
5. Endocarp, Medard Mine, × 15.

Cladium sp.
6. Endocarp, Jiří Mine, × 15.

Cladiocarya chomutovensis (BŮŽEK et HOLÝ) BŮŽEK et HOLÝ, comb. n.
7. Endocarp, Jiří Mine, × 15.

Cladiocarya cf. *lusatica* MAI
8. Endocarp, core V 3a, 31-32 m, × 15.

PLATE 32

Smilax sagittifera HEER
1. Abaxial cuticle, core HV 4, 96.5 m, × 500.
2. Abaxial cuticle of xeromorphic leaf, core HV 1, 99-100 m, × 500.
3. Abaxial cuticle, core HV 18a, 48-49 m, × 500.

Glumophyllum sp. 1
4. Stomata, core HV 1, 151-152 m, × 500.

Glumophyllum sp. 2
5. Stomata, core HV 16, 43-44 m, × 500.

Monocotyledonae gen. et sp. indet.
6. Tissue fragment, core HV 13, 154-155 m, × 500.


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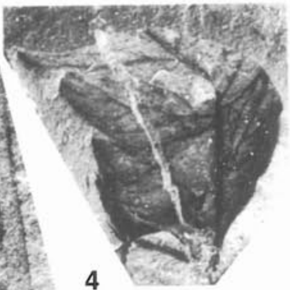
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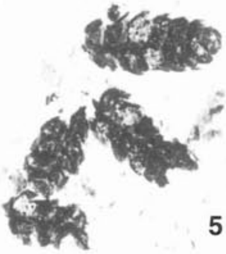
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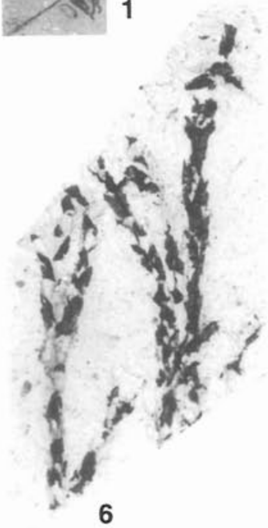
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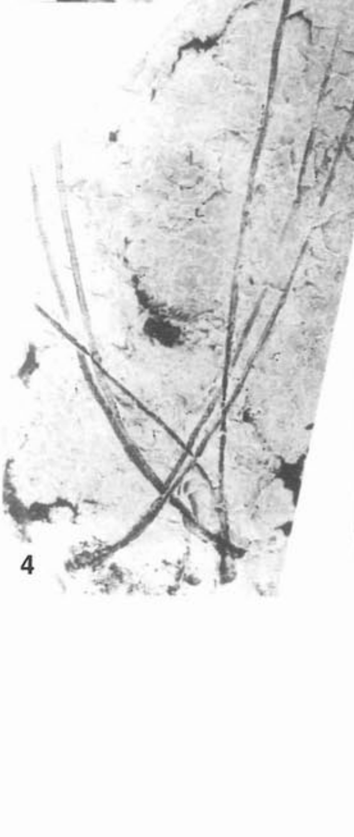
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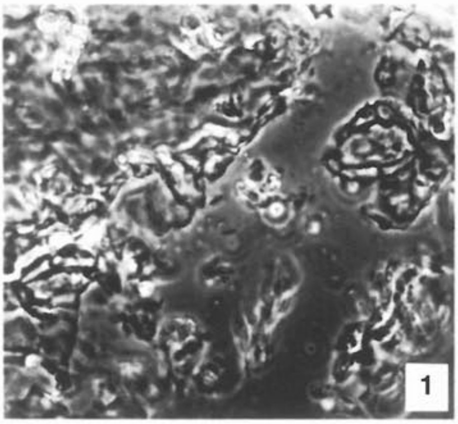
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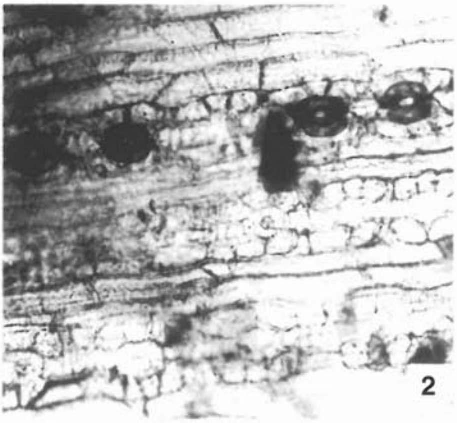
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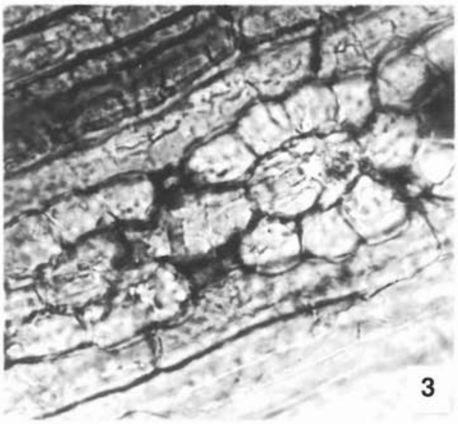
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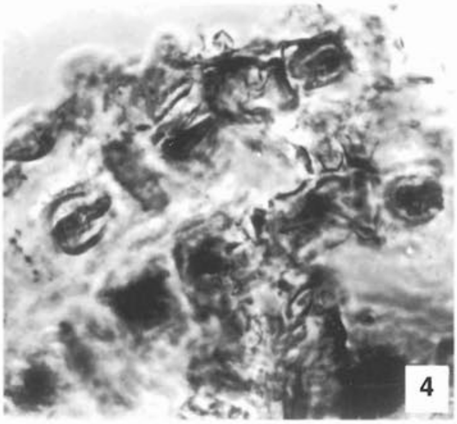
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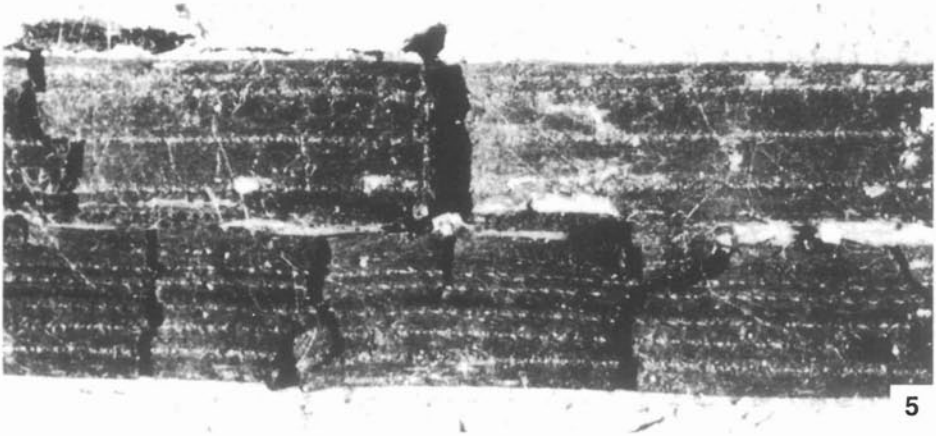
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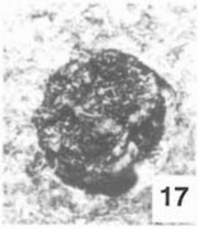
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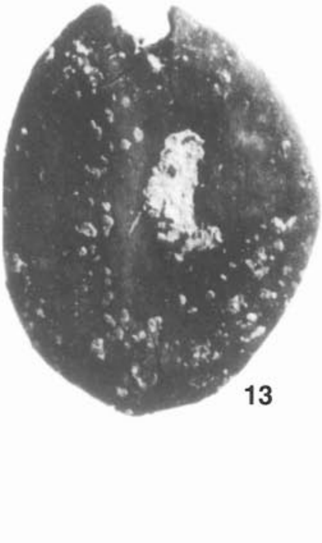
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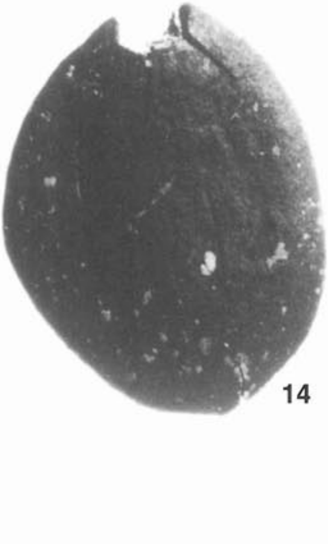
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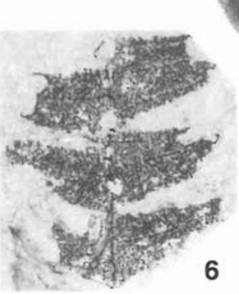
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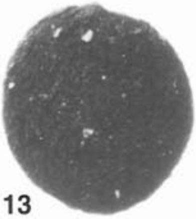
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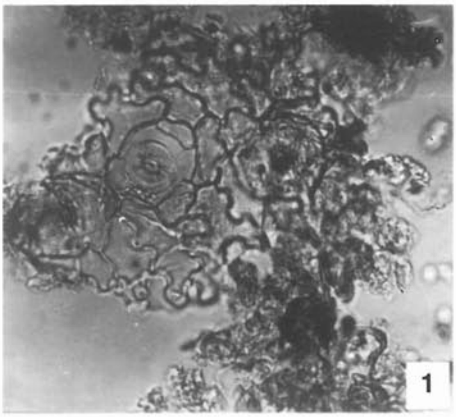
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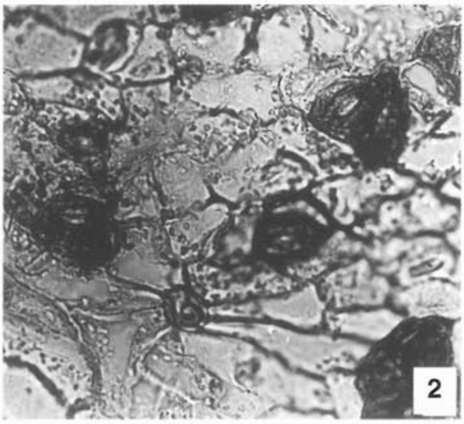
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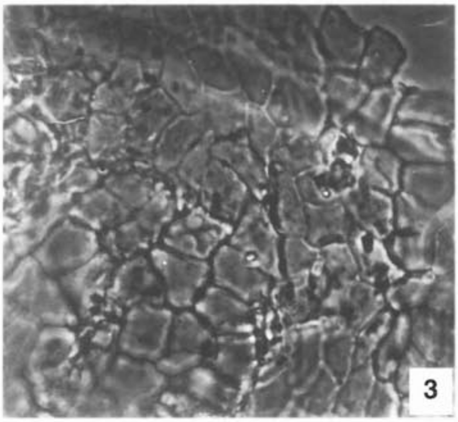
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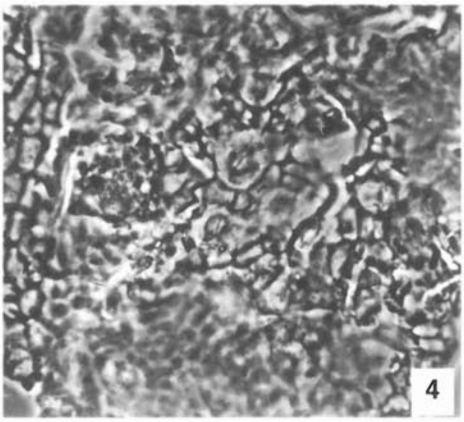
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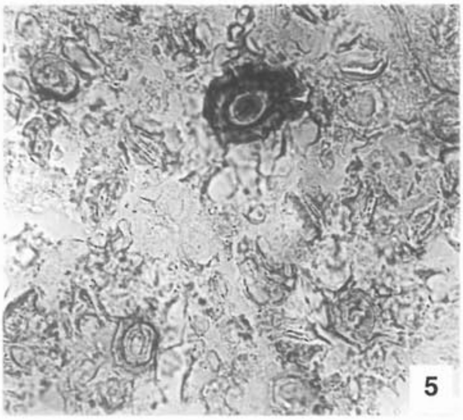
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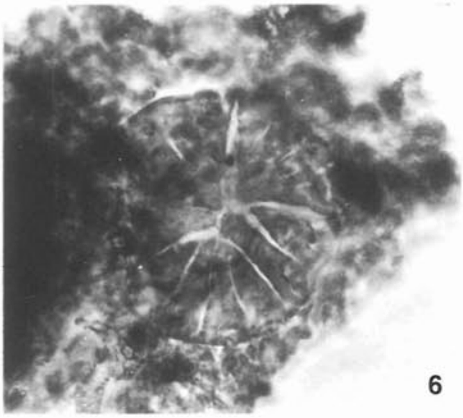
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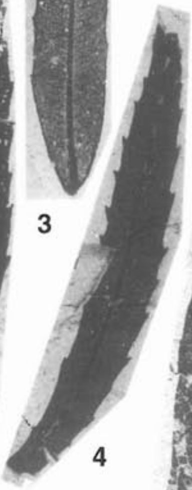
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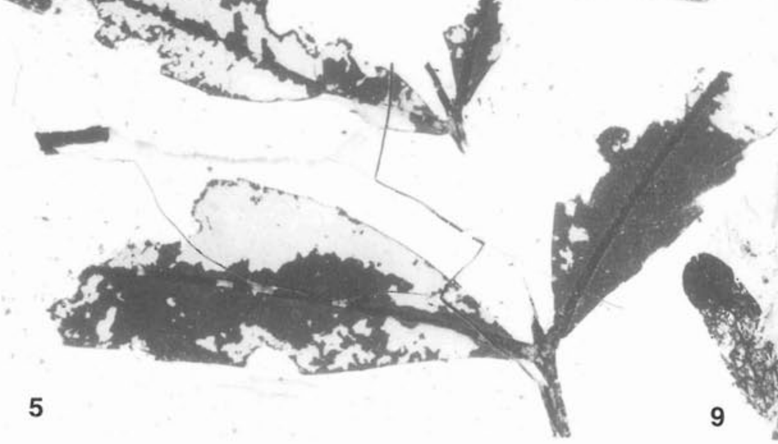
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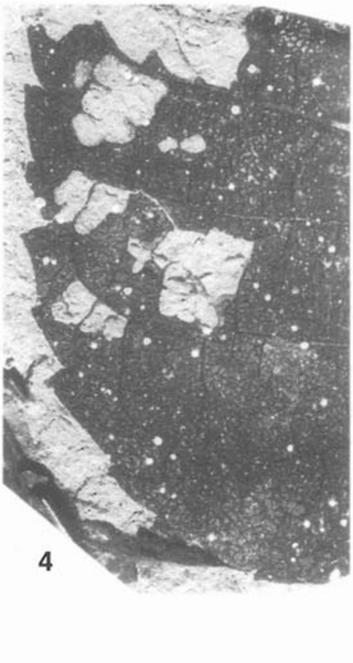

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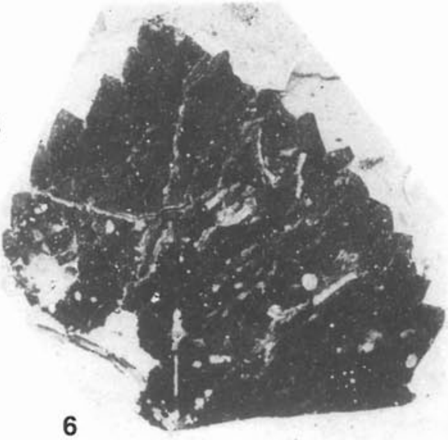
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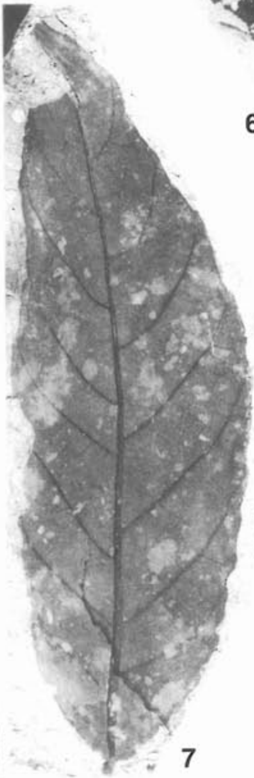
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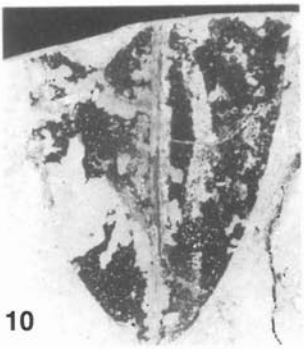
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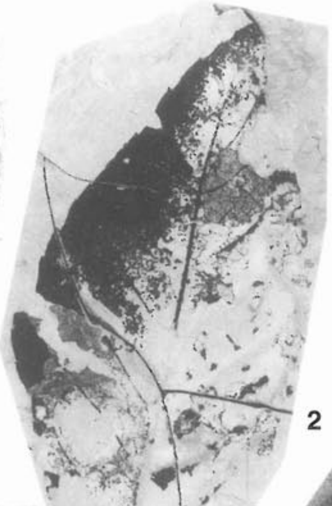
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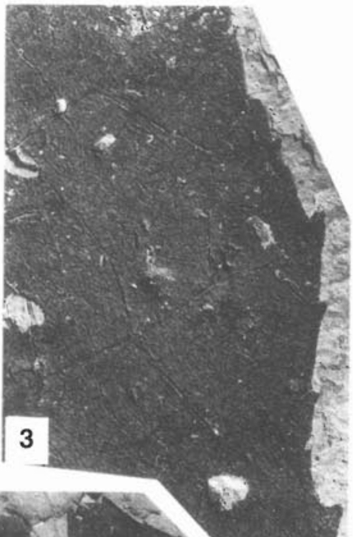
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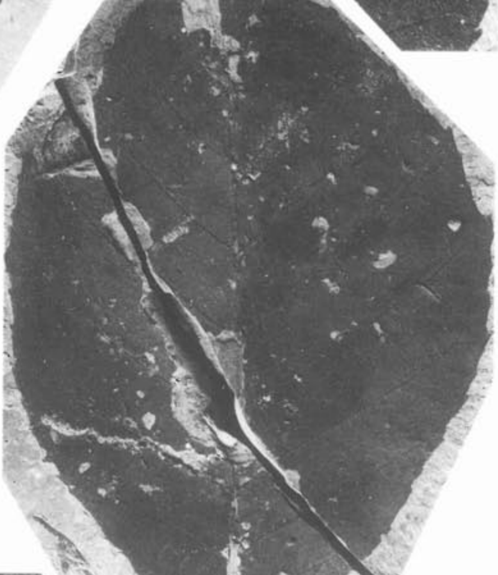
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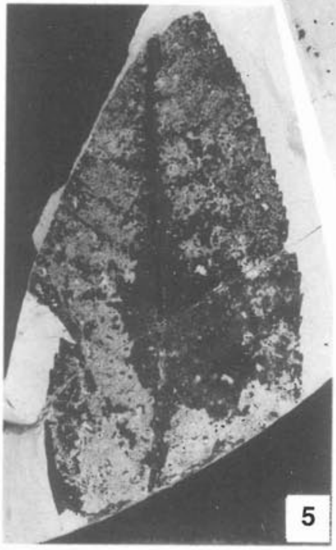
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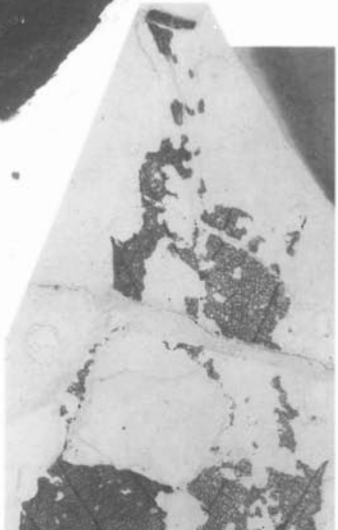

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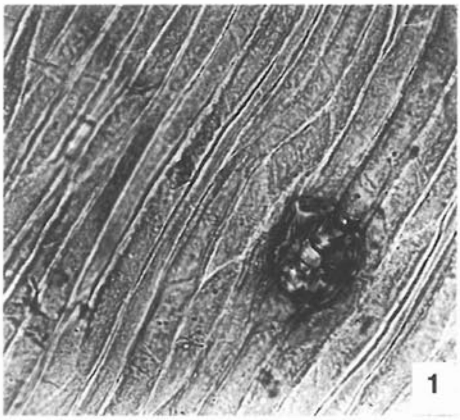
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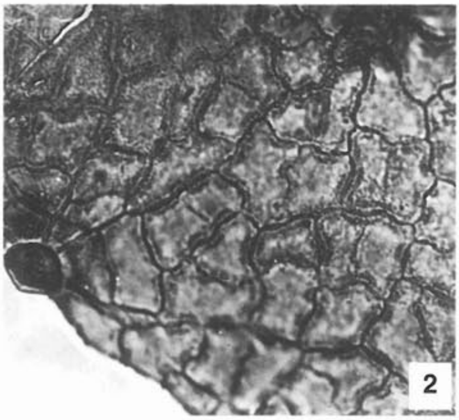
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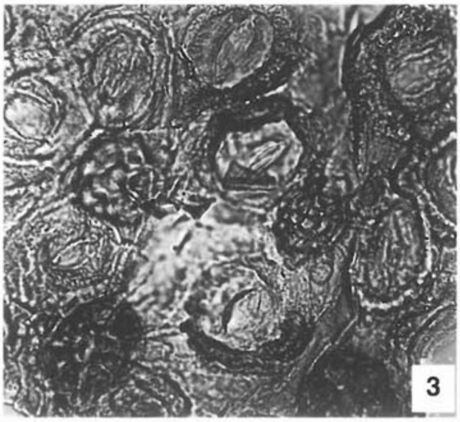
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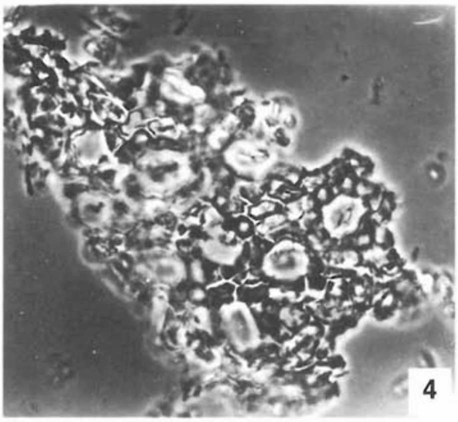
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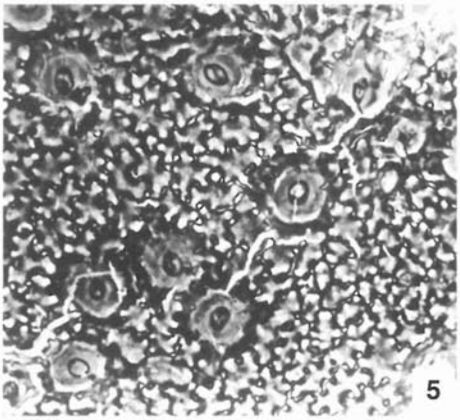
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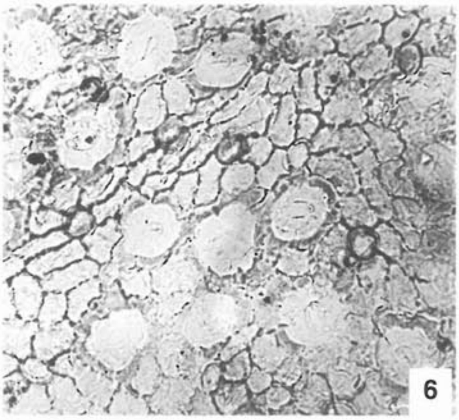
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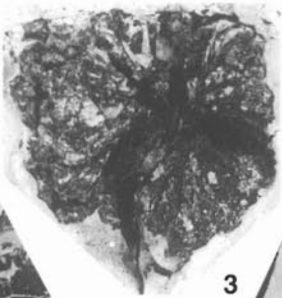

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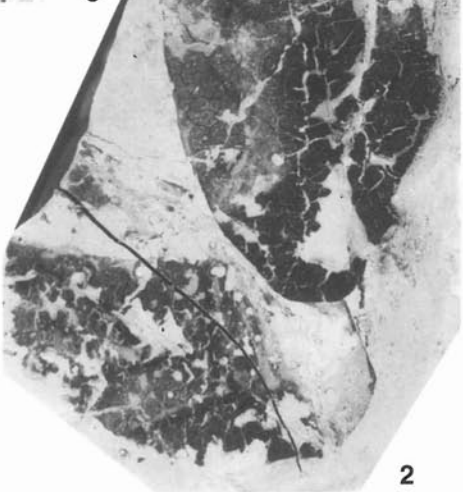

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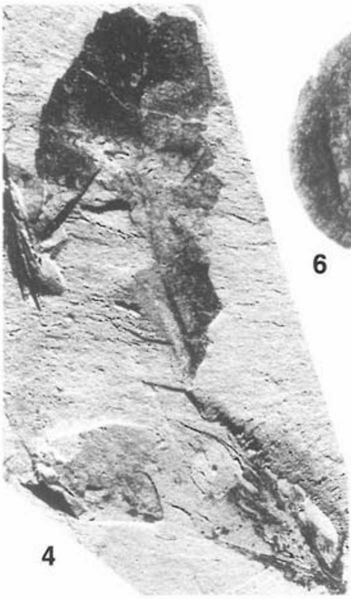

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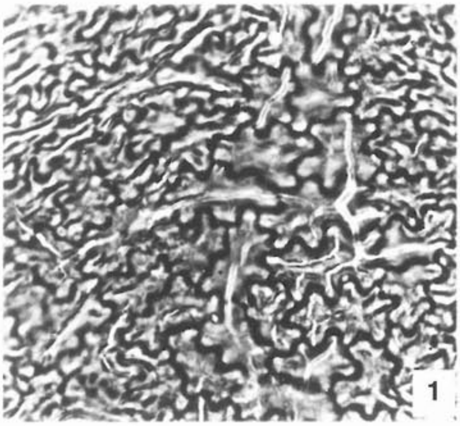
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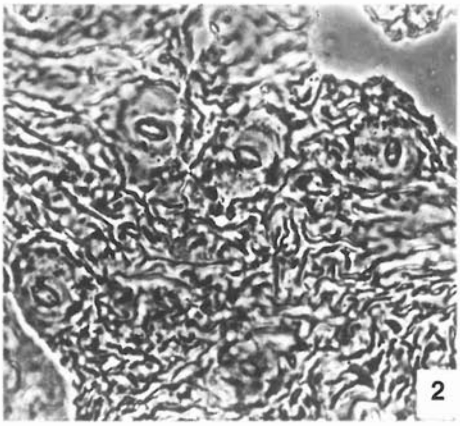
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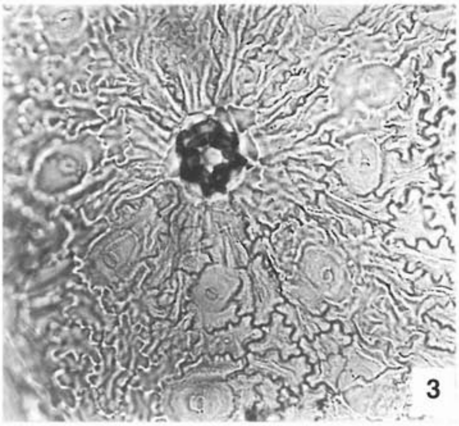
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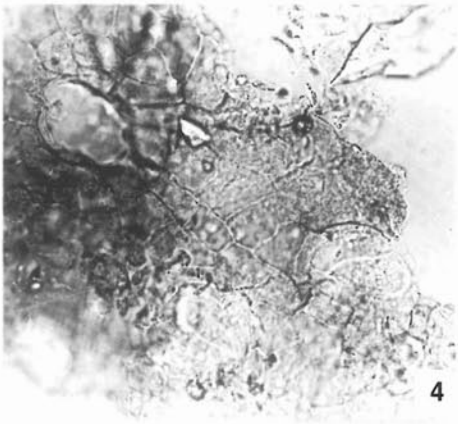
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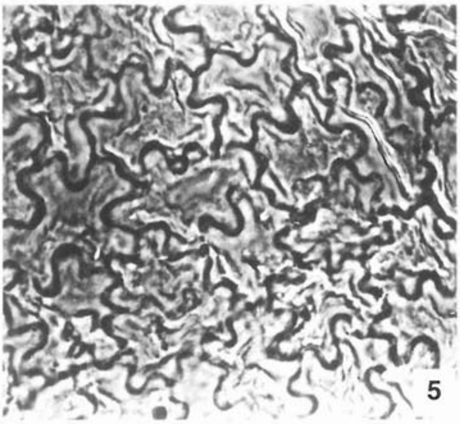
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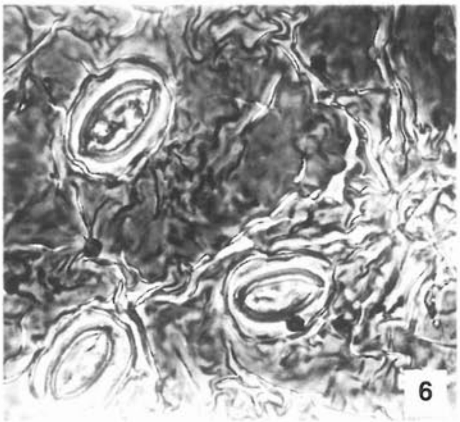
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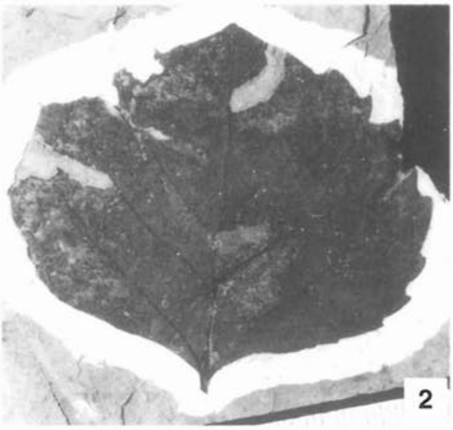
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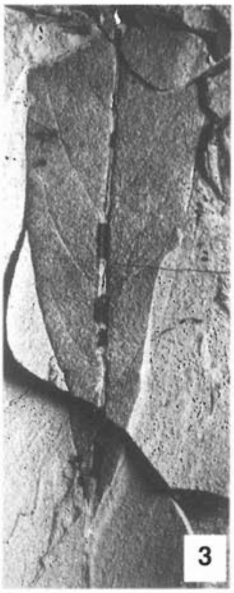
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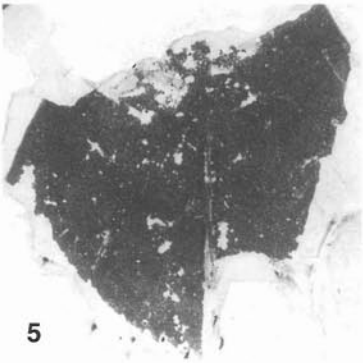
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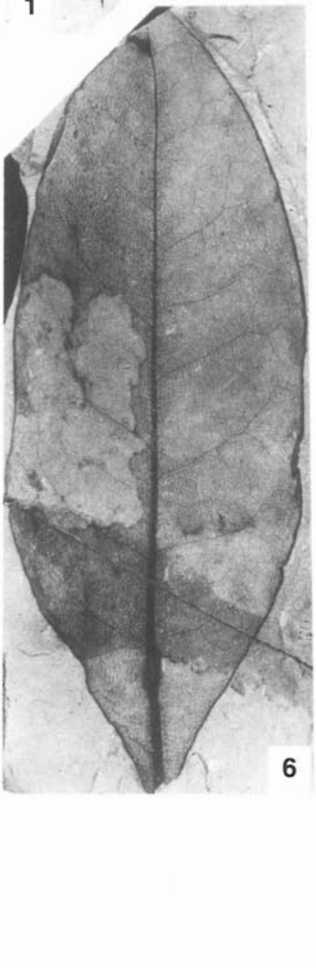
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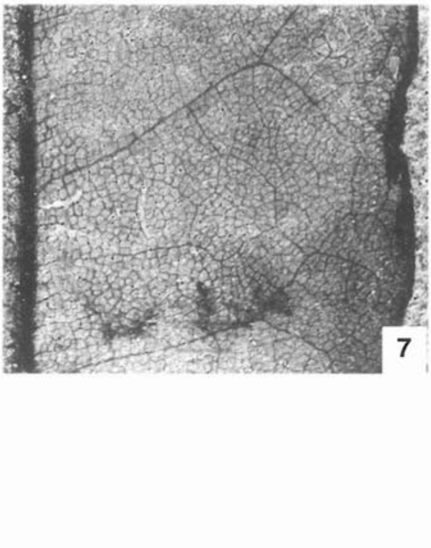
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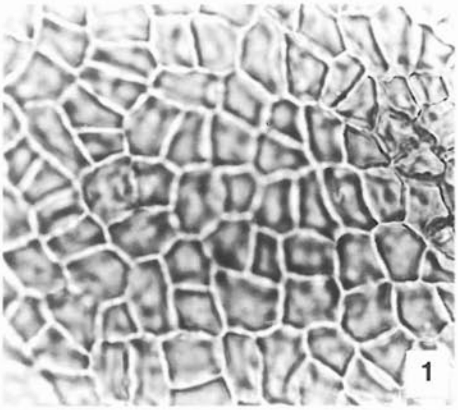
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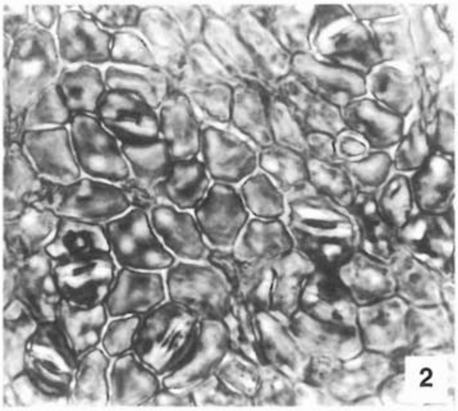
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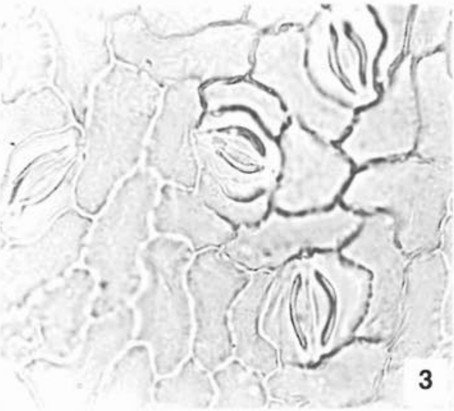
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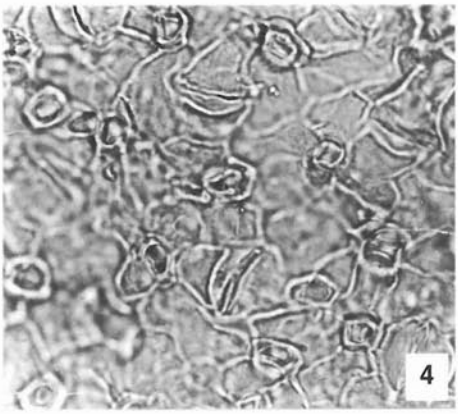
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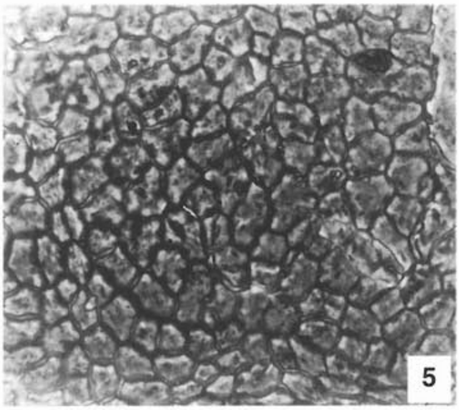
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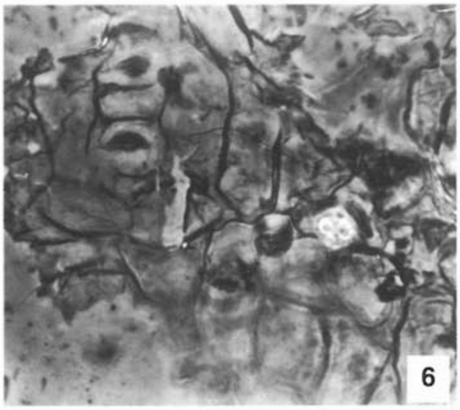
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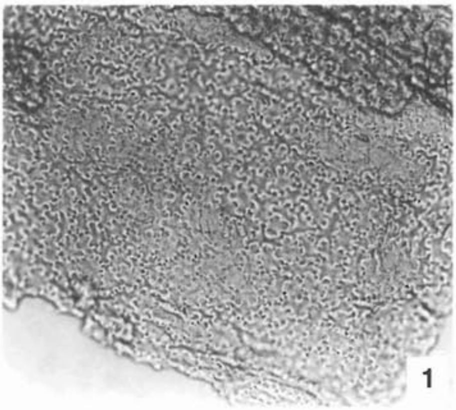
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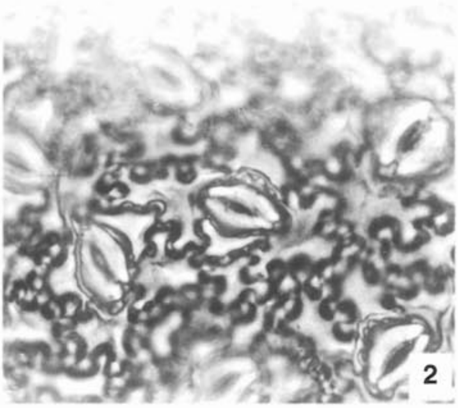
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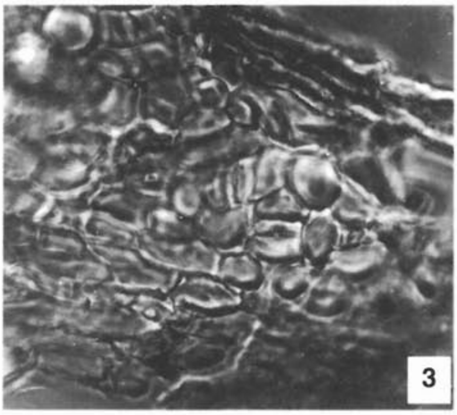
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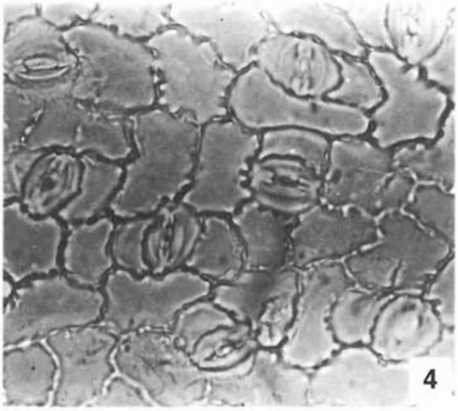
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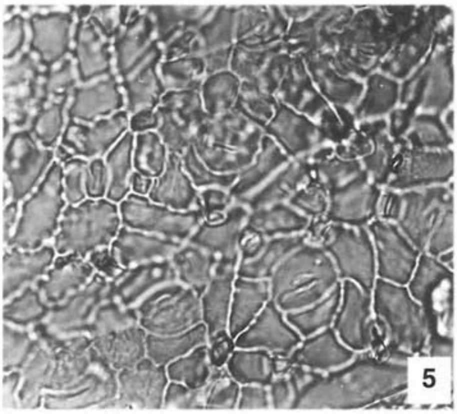
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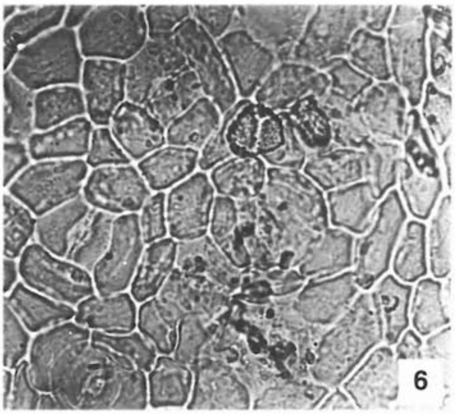
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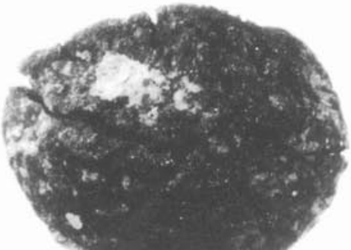
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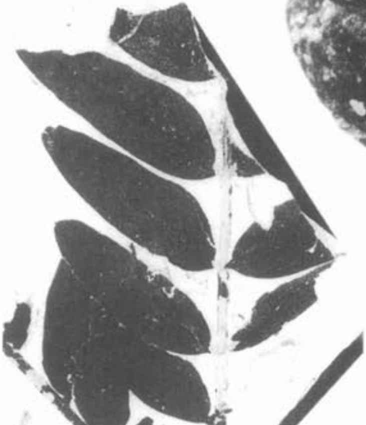
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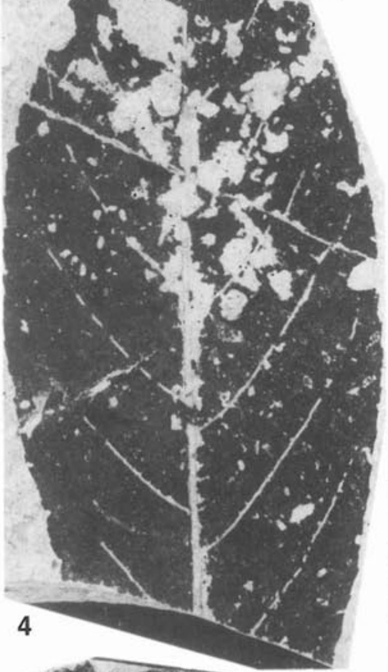
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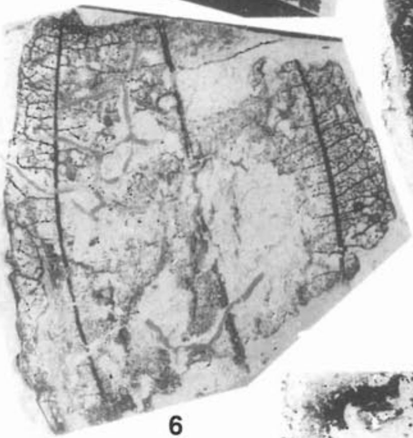
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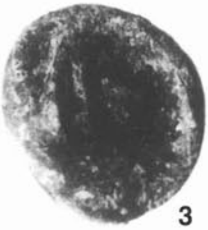
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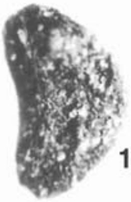
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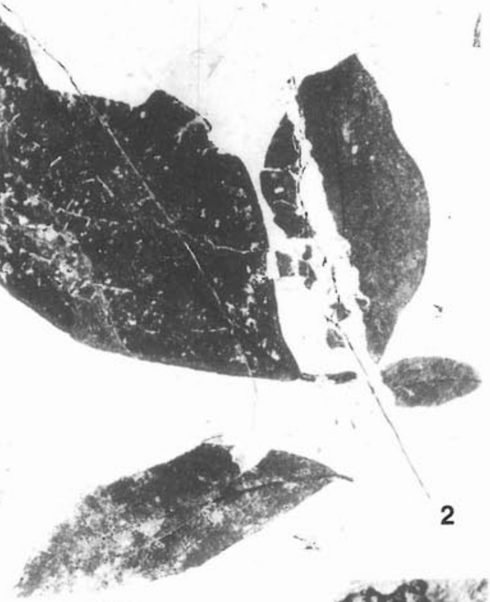
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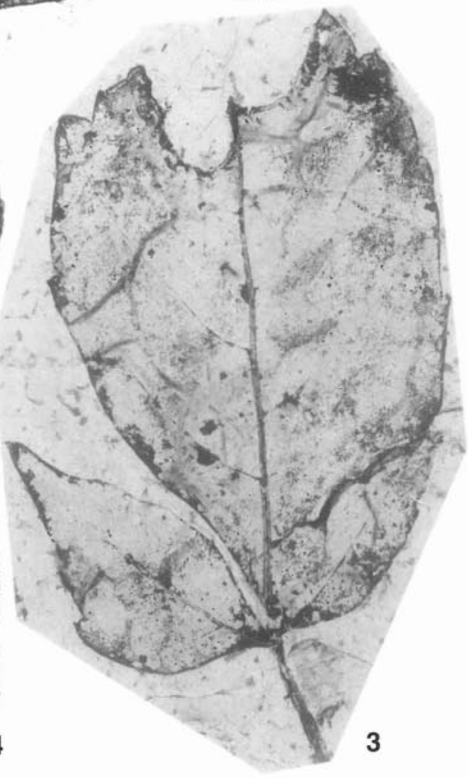
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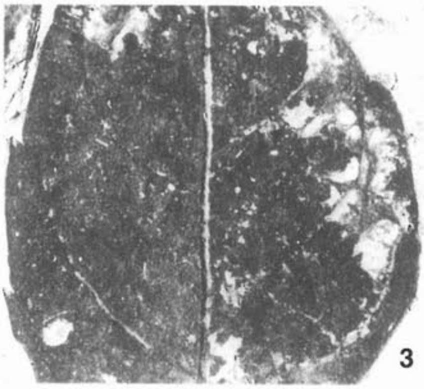
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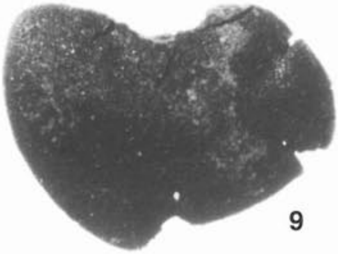
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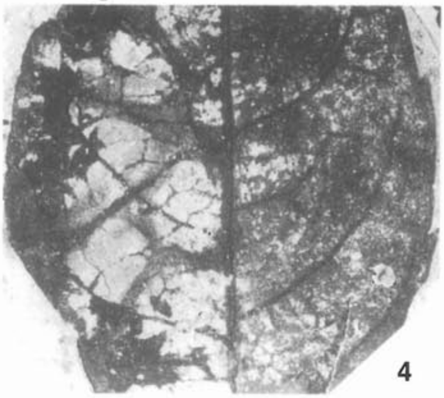
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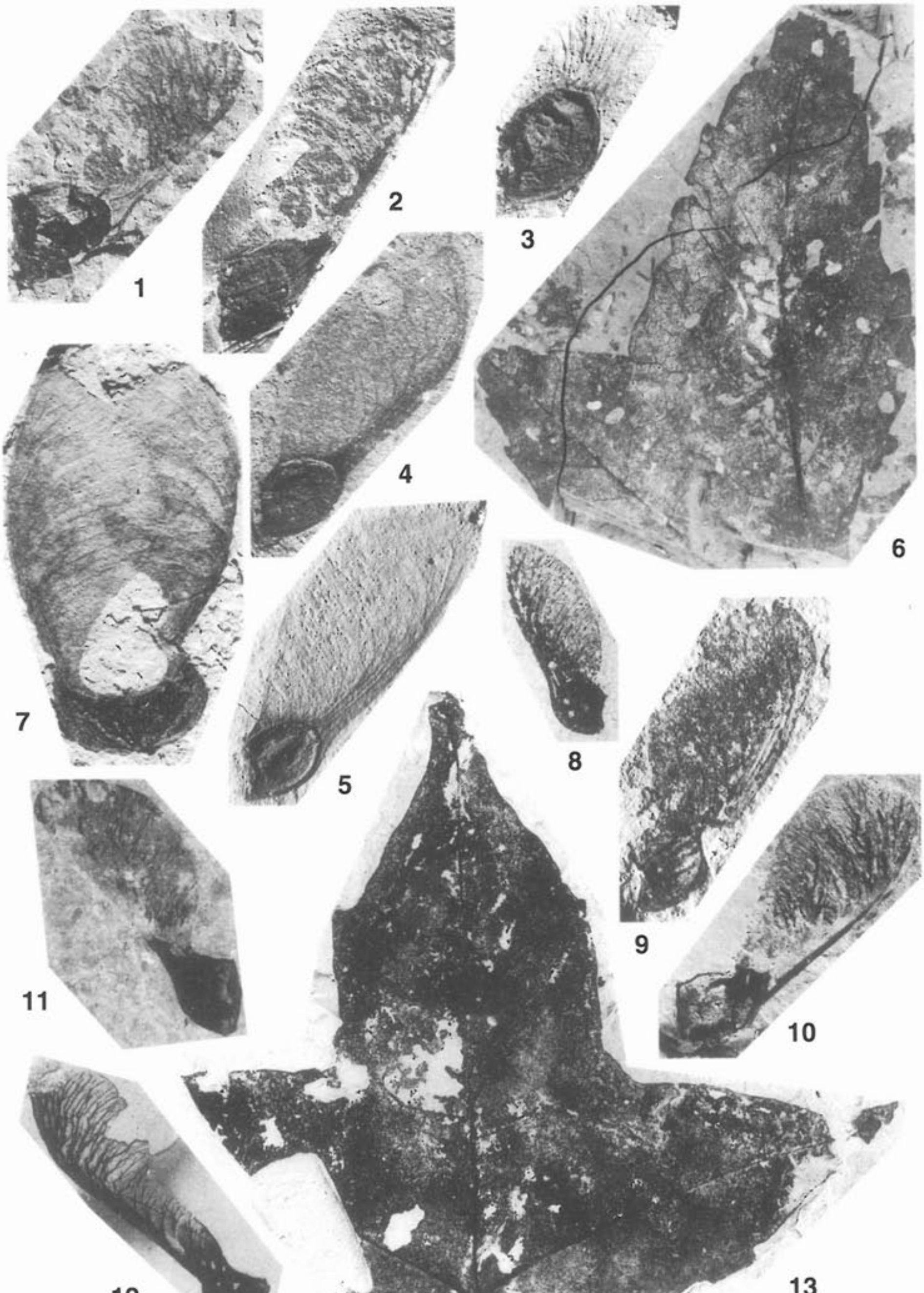
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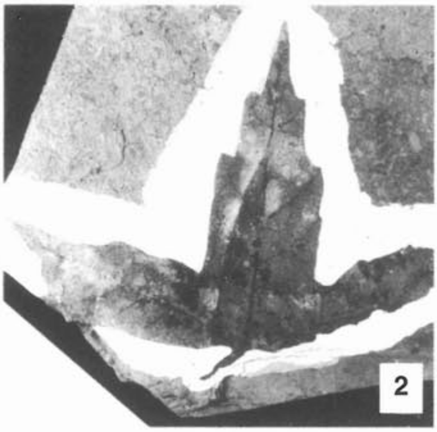
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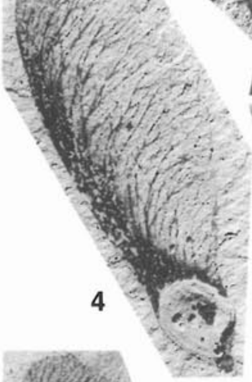
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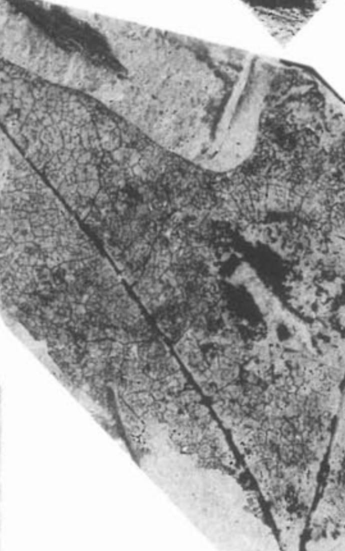
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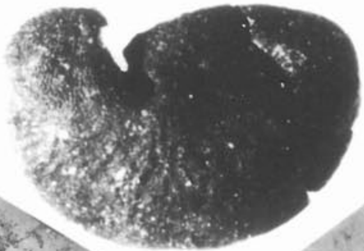
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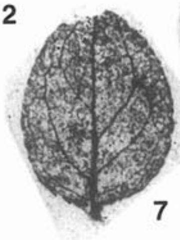
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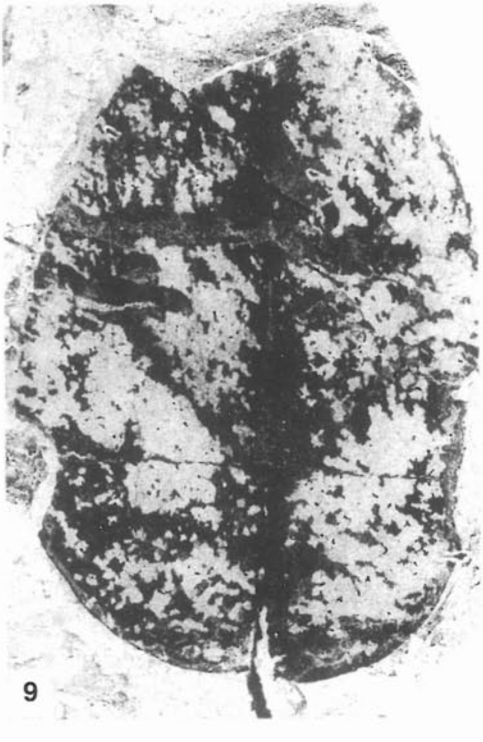
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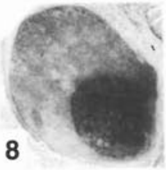
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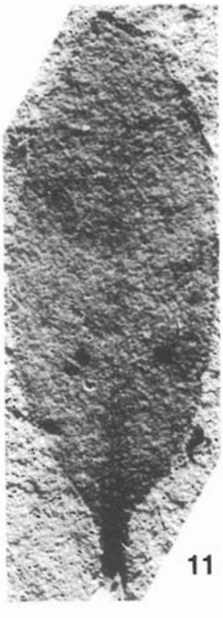
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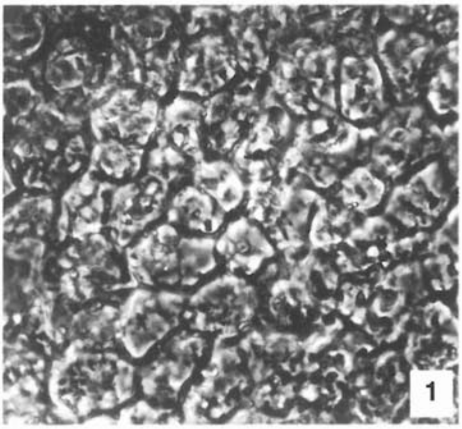
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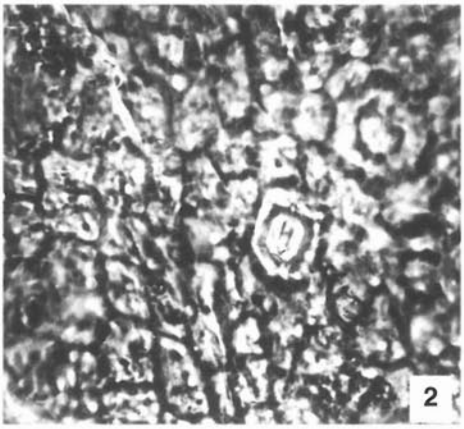
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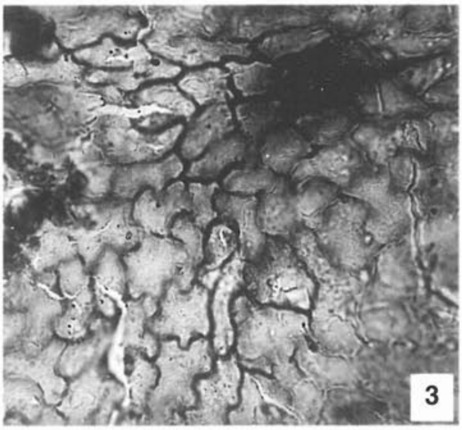
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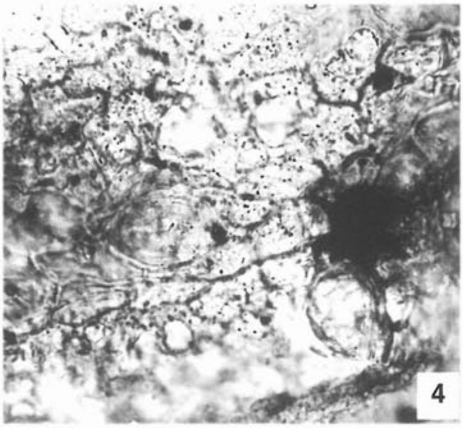
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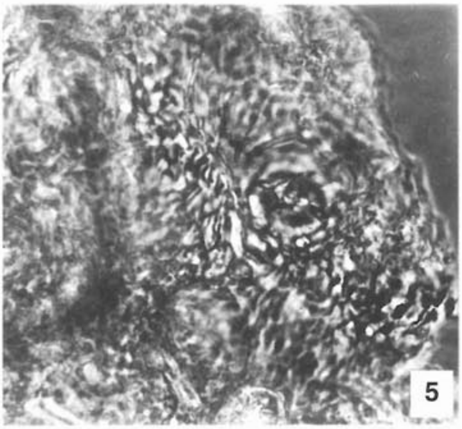
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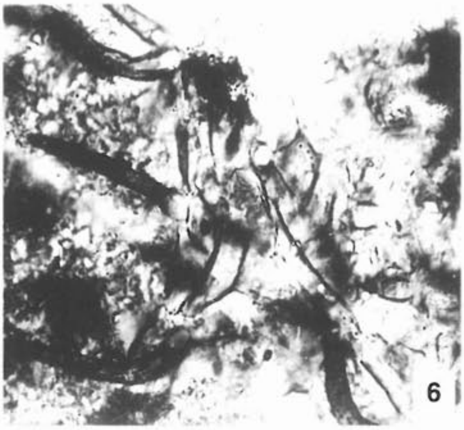
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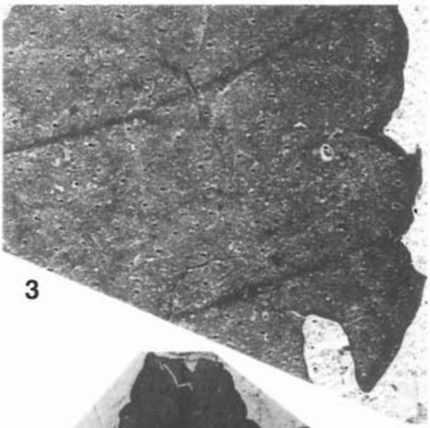
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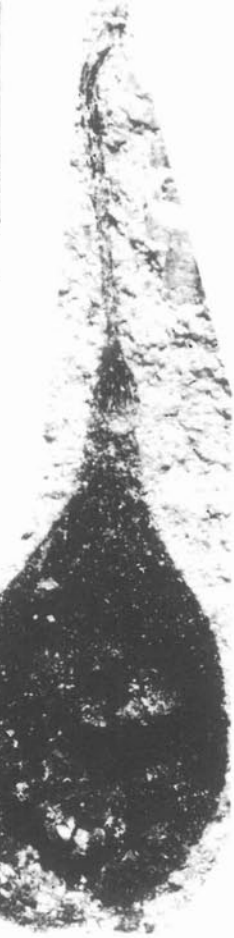
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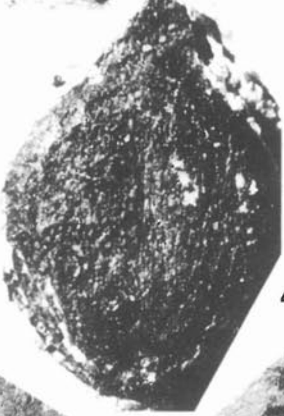
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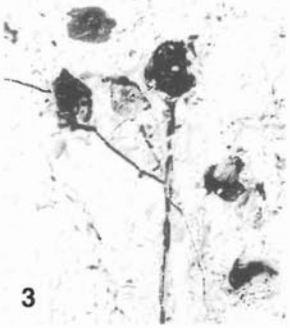
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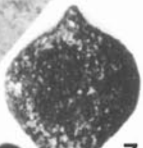
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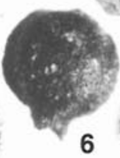
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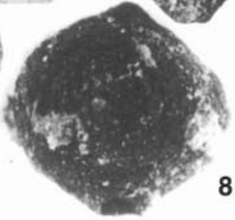
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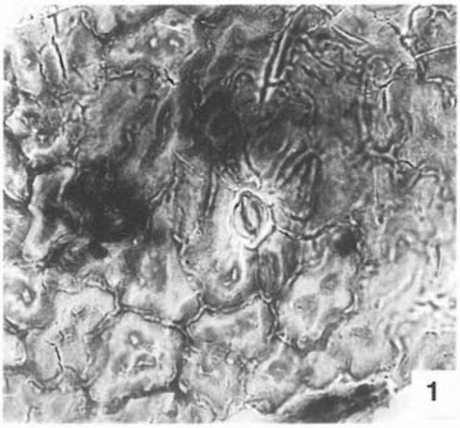
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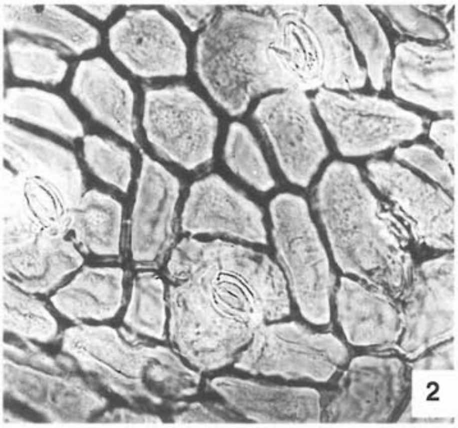
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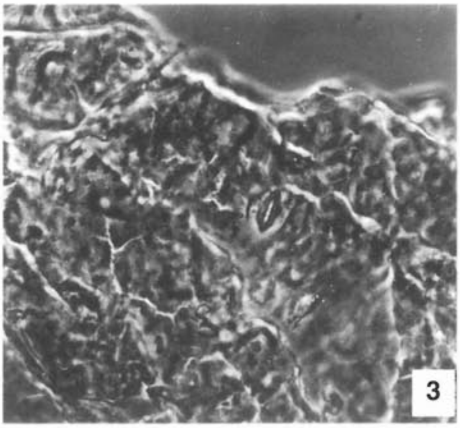
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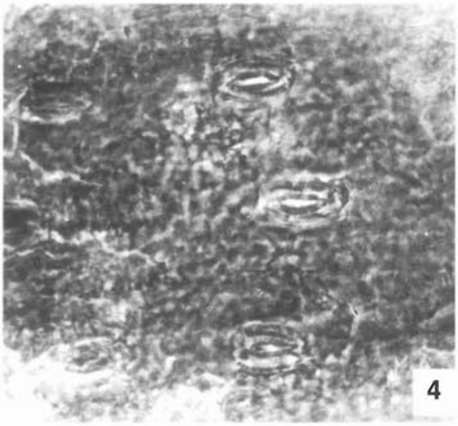
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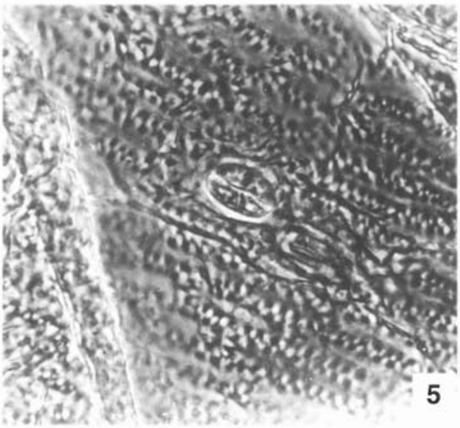
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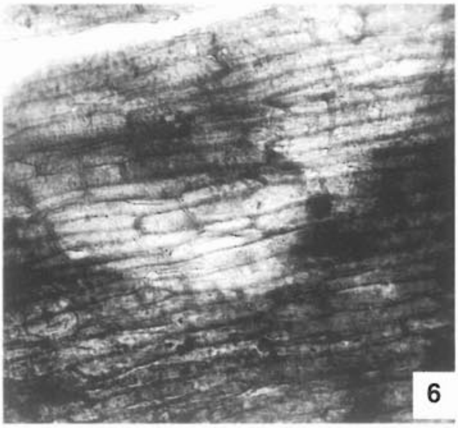
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