EARLY MIOCENE PLANT FOSSILS FROM IPOLYTARNÓC, N HUNGARY*

by

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INTRODUCTION

To the North-West of Budapest, near the border with Czechoslovakia, on the left bank of the River Ipoly, in county Nógrád is the village Ipolytarnóc. East of this village there are hills with their slopes cut by gullies. (Now the once bare slopes are covered by woods, mainly Robinia pseudoacacia.) One of the gullies is called Botos-árok, which yielded leaf remains in several places. Fossils have been collected also from Borókás ditch, Csapás valley and later from the nearby Fehér-hegy. The richest material, however, has been found in Botos-árok, figuring as "Katlan-völgy" in collections.

The majority of remains comes from the lower section of the tuff, which is about 20 to 40 cm thick. Of the three tuff eruptions that had occurred in the Miocene, this is the first, so-called "lower rhyolite tuff". This is the Gyulakeszi Rhyolite Tuff Formation. The age of the tuff could not be ascertained for a long time, earlier descriptions put it to the Upper Oligocene (Aquitanian or "Mediterranean"). According to the present stratigraphic references, the tuff eruption occurred at the boundary of the Eggenburgian and Ottnangian. Thus, the age of the tuff can be defined as Lower Ottnangian i.e. Lower Miocene. The sandstone under the tuff dates back to the Eggenburgian, and belongs to the Zagyvapálfalva Mottled Clay Formation.

The material which has been collected for decades, is in the collections of the Hungarian Geological Institute (MÁFI), the Hungarian Natural History Museum (TTM) and the Kubinyi Ferenc Museum (KFM). These materials have been revised on the initiative of Dr. Géza Hámor, who encouraged the editing of the work, and made its publication possible.

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Ipolytarnóc has long been known by European experts. It aroused the interest of scientists from all over the world, already in the eighteen-fourties. In 1836 FERENC KUBINYI, found a 42-metre-long silicified tree-trunk near Ipolytarnóc, Nógrád, in a terrain cut by streams, and called it *Petraefactum giganteum Humboldti* in honour of HUMBOLDT. He first gave information about this gigantic tree trunk in 1842. The tree-trunk measuring 3·8 m in circumference with a diameter of about 120 cm, created sensation mainly by its size.

The gigantic tree-trunk was examined by Hungarian and foreign geologitsts and palaeontologists. The first scientific examination was made by J. FELIX in 1886. He noted that it was an ancient conifer, belonging to genus Pytyoxylon. In 1901 J. TUZSON dealt with the exact anatomical determination of the fossil, and called it Pinus tarnocziensis.

In 1949 KRÄUSEL classified this find into the morphological group of *Pinuxylon succiniferum*. It was most recently examined by P. GREGUSS in 1954, who called it *Pinuxylon lambertoides*, and then in 1967 gave it the proper taxonomic name "tarnocziensis". He considers its nearest present equivalent Pinus lambertoides, living in the western regions of North America on the slopes of the Sierra Nevada, at a height of about 1000—1600 m.

The discovery of the footprints of ancient animals found in the sandstone under the silicified tree-trunk, aroused enormous interest.

Though the leaf impressions had been observed, no great attention was paid to them. M. STAUB (1889) dealt with the leaf impressions found in the sandstone, but he did not publish his work's results. The first scientific elaboration of the leaf-impressions with regard both to the flora of the sandstone and the tuff, was made by JABLONSZKY (1914, p. 230). The collection which was then relatively small, went into the possession of the Hungarian Geological Institute (MÁFI).

From the tuff he determined the following genera and species:

Dryopteris kümmerlei JABL., *Pinus tarnócensis* TUZSON, *Libocedrus salicornioides* (UNG.) HEER, *Calamus noszkyi* JABL., *Salix varians* GOEPP., *Myrica lignitum* (UNG.) SAP., *Myrica banksiaefolia* UNG., *Myrica acuminata* UNG., *Pterocarya massalongi* GAUD., *Juglans parschlugiana* UNG., *Hicoria bilinica* (UNG.) JABL., *Quercus* cf. *kutschlinica* ETT., *Ficus lobkowitzii* ETT., *Ficus urani* ETT., *Magnolia dianae* UNG., *Magnolia* sp., *Anona elliptica* UNG., *Cinnamomum polymorphum* (A. BR.) HEER, *Cinnamomum scheuchzeri* HEER, *Cinnamomum lanceolatum* (UNG.) HEER, *Laurus fürstenbergi* A. BR., *Cercis antiqua* SAP., *Evonymus* sp., *Acer trilobatum* (STERNB.) A. BR., *Rhamnus deperdita* UNG., cf. *Rhamnus prototypus* UNG., *Leucothoe narbonnensis* SAP., *Andromeda protogaea* UNG., *Sapotacites bilinicus* ETT., *Fraxinus* cf. *primigenia* UNG., cf. *Eucalyptus grandifolia* ETT., *Echitonium obovatum* UNG.

Later the collections of the Hungarian Natural History Museum (in species descriptions TTM) and of the Hungarian Geological Institute (in species descriptions MÁFI) were enriched by the collections of J. NOSZKY sen., then of Mrs. K. RÁSKY, L. BARTKÓ and F. LEGÁNYI. The great naturalist of Nógrád county, B. LIPTHAY also did some collecting in Ipolytarnóc. His collection was transferred from the Balassagyarmat Museum to the Kubinyi Ferenc Museum in Szécsény (in species descriptions KFM), where it is kept today. Thus the plant remains of Ipolytarnóc are in the possession of three museums. About 10 000 specimens of really beautiful and well-preserved remains were collected in the past decades. A long time has elapsed since JABLONSZKY's (1914) dealing with the flora. In 1959 RÁSKY, in a preliminary report, provided the description of 103 species including 11 new ones. Also her later publications contain the description of some new species and genera (1964, 1965). No detailed description and evaluation of the flora was made because of RÁSKY's death.

The list of the species published by RÁSKY (1959) is as follows:

Lobaria jablonszkyi RÁSKY, *Muscites* sp., *Woodwardites roessnerianus* UNG., *Asplenium* sp., *Lastrea stiriaca* (UNG.) HEER, *Dryopteris kümmerlei* JABL., *Pinuxylon tarnocziense* (TUZSON) KRÄUSEL, *Pinuphyllum* sp. (3 needles), *Pinuphyllum* sp. (5 needles), *Pinostrobus* sp., *Heyderia salicornioides* (UNG.) RÁSKY, *Heyderiaestrobus salicornioides* (ENDL.) RÁSKY, *Calamus noszkyi* JABL., *Sabal major* UNG., *Sabal haeringiana* UNG., *Licula* sp., *Araceophyllum* sp. div., *Araceospadix* sp., *Smilax obtusifolia* HEER, *S. franklini* HEER, *S.* sp. div., *Saururus* sp., *Piper* sp., *Pterocarya* *denticulata* (WEB.) HEER, *Myrica lignitum* (UNG.) SAP., *Quercus oligodonta* SAP., *Q. armatha* SAP., *Q. cruciata* A. BR., *Q. neriifolia* A. BR., *Castanopsis toscana* (BDLK.) KR. et WLD., *Castanopsis* sp., *Ficus persephones* ETT., *Ficus* sp. div., *Anacolosa protofrutescens* RÁSKY, *Magnolia attenuata* WEB., *M. dianae* UNG., *M. ludwigii* ETT., *Magnolia* sp. div., *Manglietia* sp., *Michelia* sp., *Kadsura breddini* WLD., *K. protowightiana* RÁSKY, *Kadsura* sp., *Talauma* sp., div. *Illicium fliegeli* WLD., *Magnoliaestrobus hungaricus* RÁSKY, *M. noszkyi* (JABL.) RÁSKY, *Polyalthia* sp. div., *Orophea* sp., *Alphonsea* sp. div., *Cinnamomophyllum scheuchzeri* (HEER) KR. et WLD., *C. polymorphum* (A. BR.) KR. et WLD., *Actinodaphne* sp., *Laurus primigenia* UNG., *Dehaasia* sp., *Lindera styracifolia* (WEB.) RÁSKY, *L. stenophylla* (ETT.) RÁSKY, *Lindera* sp. div., *Litsea magnifica* SAP., *L. grandifolia* (ETT.) RÁSKY, *L. mülleri* FREIDR., *Litsea* sp. div., *Persea* sp., *Phoebe* sp. div., *Laurocarpum* sp., *Lauropetalum* sp., *Pittosporum* sp., *Dalbergia* sp. div., *Leguminocarpum* sp., *Antholithes leguminosoides* (vexillum), *Ilex rottensis* WLD., *Evonymus* sp., *Acer trilobatum* A. BR., *Sapindus* sp., *Xerospermum* sp., *Meliosma* sp., *Elaeocarpus* sp., *Scolopia protolusonensis* RÁSKY, *Scolopiaephyllum* sp., *Barringtonia* sp., *Terminalia* sp., *Eugenia* sp., *Memecylon* sp., *Schefflera gaudini* (SAP.) RÁSKY, *Sch. protomicrophylla* RÁSKY, *Sch. protomulticaulis* RÁSKY, *Sch. protolucescens* RÁSKY, *Schefflera* sp. div., *Macropanax* sp., *Acantopanax* sp., *Aralia ilicifolia* SAP., *Antholithes araliaeformis* RÁSKY, *Myrsine formosa* HEER, *Sapotacites delprati* CRIÉ, *Sapoticarpum* sp., *Diospyros brachysepala* A. BR., *Diospyros* sp., *Diospyros rugosa* SAP. (calyx), *Symplocos* sp. div., *Osmanthus dianae* (ETT.) RÁSKY, *Tricalysia protojavanica* RÁSKY.

For a long time this list of species served as a basis of approach to the Ipolytarnóc flora. This, however, in the light of our present knowledge, needs revision. In many cases it was found that Rásky considered as different some remains belonging to the same species. This will be discussed in the chapter dealing with taxonomy where description of each species is given. The validity of many "new" genera and "new" species described by RÁSKY is difficult to prove without epidermis analyses. Some have already been unequivocally proved not to be new species. A great number of remains of the same genus, listed under several names of species, have been proved to belong to the same genus.

The flora of the tuff has not been dealt with since RÁSKY. The flora of the sandstone of a different age was re-examined by PÁLFALVY (1974), but this flora is much poorer than that of the tuff, and so the content of the information is also poorer. In the course of re-checking *Engelhardtia orsbergensis*, Jähnichen (JÄHNICHEN et al. 1977) and *Quercus cruciata*, KVAČEK and WALTHER (1981) dealt with some species of the Ipolytarnóc flora.

SYSTEMATIC DESCRIPTION OF LEAF REMAINS FROM THE GYULAKESZI RHYOLITE TUFF FORMATION

Stictaceae
Lobaria SCHREBER

Lobaria jablonszkyi RÁSKY

Pl. I, Figs. 1—4, Pl. II, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.*

Description: See RÁSKY, 1959. p. 456.
Locality: Ipolytarnóc, Botos-árok I, II, IV, V, Fehér-hegy.

Blechnaceae
Woodwardia SMITH

Woodwardia muensteriana (PRESL in STERNBERG) KRÄUSEL

Pl. II, Figs. 2—5.

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves pinnate. Leaflets not fully separated, attached to each other near the rachis. Towards the apex the area of attachment is larger; on both sides of the rachis 0.4—0.4 cm moving away from the apex, the leaflets present ever larger divisions. The distance of the lobes from the rachis is not more than 1—2 mm in the lower section of the leaflet. The angle at which the leaflets arise from the rachis is $\pm 60°$. The leaflets are serrate, their polygonal vein network is well visible. The rachis is thick, the midveins of the leaflets are considerably thinner. Moving away from the apex the size of the leaflets show small increase. The apex is formed by irregularly shaped uniform acute lamina. In the absence of full leaf remain the number and size of leaves are unknown.

Note: The *Pecopterys münsteriana* species has been named Woodwardites by BRAUN (1841), because of its similarity to the recent Woodwardia genus. GOEPPERT (1857) identified it with recent species of *Woodwardia radicans* (L.) Sw. On more detailed examination of the plant, it turned out, however, that its recent equivalent is *W. virginiana* SM.

The species is known from several Miocene localities from Europe, nearest in Czechoslovakia from Petipsy Area, younger strata than those of Ipolytarnóc (BŮŽEK, 1971).

Locality: Ipolytarnóc, Botos-árok II, V.

Thelypteridaceae
Pronephrium PRESL.

Pronephrium stiriacum (UNGER) KNOBLOCH et KVAČEK

Pl. III, Figs. 1, 4.

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Fragments of the pinnate leaf have been found. The leaflets were attached to a thick rachis. The leaflets are dissected, they are attached to each other at the median third, forming a uniform lamina, with only their apices standing out. The venation forms a network on the lamina, as if

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* Figures in boldface represent the year of collection and the year of inventory.

they were leaves, separated from each other. There is a thick midvein in the middle of each leaflet, from which curved venation arises on both the right and left sides, similarly to the Dicotyledons. There are no veins on the lamina between the rounded sections.

Note: Rásky (1959) did not publish the description of the species, but it can be found by the name *Lastraea stiriaca* in her Hungarian Natural History Museum collection. In the same place similar impressions of *Lastraea oehningensis* can be found, which come from the Eger-Tihamér Middle Miocene flora. In our opinion these are the same as the ones from Ipolytarnóc. By the name *L. oehningensis,* this species figures also in the Egerian flora of the Wind brick factory section. These prove, that this species was present in Hungary from the end of the Oligocene to the middle of the Miocene. It most frequently occurred in the Miocene. Its oldest locality in Europe is known from Bulgaria, where it was found in Palaeocene strata. Its most recent occurrence is known to be Pliocene in Rumania. It is questionable, however, if all the finds really belong to the same species, or the similarity between them is only morphological.

Locality: Ipolytarnóc, Botos-árok II, V.

Polypodiaceae

Dryopteris Adams

Dryopteris kümmerlei Jablonszky

Pl. III, fig. 3.

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaf very fragmentary. Rachis thick, strong, and gives off leaflets with thick midveins running along them. The leaflets are further articulated, flat at the base, and grow ever smaller towards the apex. Their apices are fragmentary and they are attached to each other at their bases. The individual leaflets are detached, each joining the rachis by itself, and they are not attached even at the base.

Note: Jablonszky mentions only one remain of the species from Ipolytarnóc, described above. Later some collections were made by Legányi from Botos-árok locality III. This impression is in the collection of the Hungarian Natural History Museum.

Asplenium Linné

Asplenium sp.

Pl. III, Fig. 2, Pl. IV, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Small fragmentary impressions. The rachis runs in zig-zag line. The leaflets arising from it, are attached near the rachis. The leaflets broaden towards their apices, where they end in rippled margin, characteristic of Asplenium. The midveins of the leaflets are considerably thinner at the rachis. They give off further veins at both sides, which end in rippled margins.

Only small fragments were found, from which the full size of the leaf cannot be ascertained.

Note: Asplenium sp. figuring in Rásky's list of species (1959) can be found in the collection of the Hungarian Natural History Museum, under the name *Asplenium hungaricum* Rásky.

Locality: Ipolytarnóc, Botos-árok II.

Cupressaceae

Libocedrites Endlicher

Libocedrites salicornioides (Unger) Endlicher

Pl. IV, Figs. 2—4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: A great number of shoots of different sizes have been found. The leaf-whorls join each other in a characteristic way, they decrease in size towards the tip of the shoot. Though considerable quantity of it has been found, it is not a dominant species, because some other species were found in large quantity.

Note: In Hungary this species was found also in the Lower Oligocene Tard Clay Formation, but not in a dominant quantity. From the Upper Oligocene only one leafwhorl could be presented (HABLY, 1982) from Vértesszőlős. There are impressions known from the Wind brickfactory in Eger, from the Egerian, and from the Mecsek Mts from the Karpatian (PÁLFALVY, 1963).

It was also found in Erdőbénye in the Sarmatian tuff (ANDREÁNSZKY, 1955). In Czechoslovakia it is a wide-spread species, characteristic of the Upper Oligocene. Its ecological demands and exact taxonomic status is still unclarified.

Locality: Ipolytarnóc, Botos-árok I, II, IV, V, Fehér-hegy.

Pinaceae

Pinus LINNÉ

Pinus saturni UNGER

Pl. V, Figs. 1, 2

List of species, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Pine-needles thin, long, generally several needles are together. At the tip of the shoots they literally form clusters, they are to be found in abundance. Their full length is not known, the relatively intact specimens are 14—15 cm long. One bunch probably had three needles. In addition to needles, fragments of shoots also remained, on which the traces of the fallen leaves can be seen.

Locality: Ipolytarnóc, Botos-árok V.

Pinus sp.

Storage place and collection numbers of the material are to be seen in the Hungarian text.

Note: Here we classified those fragmentary pine-needles, which had no characteristics at all. Neither can the number of their needles, nor their length be established. Thus, their taxonomic status cannot be determined. Pine-needles and cones are mentioned also by TUZSON (1901), RÁSKY (1959), and PÁLFALVY (1976), from the sandstone; the latter being in the collection of the Hungarian Geological Institute. The material, however, was not available in the time of the rechecking.

Pinuxylon

Pinuxylon tarnócziense (TUZSON) GREGUSS

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Note: Silicified tree-trunk remains are not examined in this study, they are mentioned only for the sake of completeness.

Magnoliaceae

Magnolia LINNÉ

Magnolia dianae UNGER

Pl. V, Figs. 3—5, Pl. VI, Figs. 2—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves large with length 10 to 14 cm, and breadth 4 to 5.6 cm (Table 1). Lamina elliptical or slightly obovate. Towards the base it tapers more than towards the apex. Base acute, decurrent, apex also acute, mostly acuminate. Leaf margin entire. Venation camptodromous. Midvein thick, near the base it generally as thick as 1 mm. Compared to it, secondary veins are thin, but very characteristic. Arising from the midvein, they run steeply upwards in a quite short section, then they flatten and continue forming an angle at 50—70°. At the leaf margin they curve upwards, connecting in loops. The sections between the loops are closed by other loops. The midvein gives off a relatively thick intermediate vein between the secondary veins, and in many cases there are even two intermediate veins. The secondary veins form irregular loops, which seem to branch off at the leaf margin. The connection of these branches results in either wide round or acute loops. The intermediate veins end freely in the network of the tertiary veins, which articulate the full surface of the lamina into small polygonal areoles. The leaf—according to its state of preservation—may have been leathery.

Comparison: A few *M. dianae* UNG. impressions in the collection of the Natural Science Museum come from the original material of Unger. The Radoboj leaves are somewhat larger than the impressions in Hungary, but all the other characteristics are the same.

Note: Some specimens were found in the flora of the Wind brick-factory in Eger (Upper Oligocene), from the Ottnangian and Karpatian formations of the Mecsek Mountains, as well as from the Sarmatian deposits of the Uppony Mountains (Szelecsi-völgy).

Locality: Ipolytarnóc, Botos-árok I.

Magnolia kristinae KNOBLOCH et KVACEK

Pl. VI, Figs. 1, 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Lamina strongly elongated elliptical. Leaf apex acute, leaf base cuneate. Leaves are 1.2 to 2.4 cm wide, their length cannot be measured exactly, but it exceeds 8 cm. Leaf margin entire. Midvein thick, secondary veins relatively thin. The angle at which the veins arise between 60° and 80°. At a distance of 1 or 2 mm from the leaf margin, there is a loop-like interconnection which brings about a brachydodromous venation. There is a loop network of small loops between the loops and the margin. The space between the secondary veins is divided into tiny polygonal areoles by the tertiary and quaternary veins.

Note: The species was described from Wackersdorf from the Miocene (Karpatian—Middle Badenian).

Locality: Ipolytarnóc, Botos-árok I, V.

Magnolia mirabilis KOLAKOVSKIY

Pl. VII, Figs. 1—3.

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves 13 cm long, about 6 cm wide, tapering towards the base and the apex. Leaf margin entire. Midvein thick, venation brachydodromous. Also secondary veins thick, characteristic loop network produced by them towards the margin. Midvein gives off intermediate veins, too, these interconnect in loops with the secondary veins below them. Between the secondary veins, marked vein network formed, devided also by the quaternary vein network. Secondary veins arise at a large distance, about 2 cm from one another, at 40—42° in the median third of the lamina.

Note: The species has also been found in the Vértesszőlős flora from the Egerian (HABLY, 1982b). The preservation of the Ipolytarnóc remains show well the leathery nature of the leaf. In the Ottnangian flora of Ipolytarnóc, the species acts only as a variety element.

Locality: Ipolytarnóc, Botos-árok.

Magnoliaestrobus SEWARD et CONWAY

Magnoliaestrobus hungaricus RÁSKY

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 457.

Magnoliaestrobus noszkyi (JABLONSZKY) RÁSKY

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 457.

Persea braunii HEER

Pl. VII, Fig. 4, Pl. VIII, Figs. 1—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves large with broad lamina; there is only one small impression. Lamina slightly obovate. Leaf margin entire. The preservation shows the leaf to be thick and leathery. Leaf base acute, slightly asymmetrical, apex fragmentary in all specimens, but tapering of the lamina towards the apex can be observed. Venation strikingly marked. Secondary veins arising from the midvein, are very thick. Venation brachydodromous. Secondary veins connect in curves near the margin, and here the connecting loops show strong, visible venation. To these veins there are further loops attached towards the margin of the leaf, which are brought about by tertiary veins. The secondary veins arise from the midvein at regular intervals on the larger and broader leaves. This regularity cannot always be observed on the smaller leaves. Secondary veins running towards the leaf margin, are diverging in the broad section of the lamina, and are approximately parallel in the narrower basal sections. They arise from the midvein at 47—55°, flatly at the base and steeply in upper sections. The tertiary and quaternary vein network forms dense polygonal network between the secondary veins.

Comparison: The leaves totally agree with the specimens presented by HEER (1856). Its plant taxonomic status is uncertain. Venation of similar type can be observed with other genera. From Ipolytarnóc almost the very first collections yielded impressions of this genus. JABLONSZKY describes it by the name *Anona elliptica* UNG. (1914), and considers it identical with *Anona elliptica*, described from the Radoboj flora, but points out, that similar leaves can be found with other genera, too. Our examination material has turned out to be identical also with the impressions presented by NĚMEJC—KNOBLOCH (1973). From the original Radoboj collection of UNGER we compared it with *A. elliptica*, but found no similarity. It differs from the Radoboj find both in shape and venation.

Locality: Ipolytarnóc, Botos-árok I.

Persea speciosa HEER

Pl. VIII, Fig. 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text

Description: Lamina elongated elliptical or slightly obovate. Leaf margin entire, apex acute, base cuneate. Venation brachydodromous, secondary veins tapering towards the margin, forming multiple loop network. Midvein markedly thick, strong. Secondary veins considerably thinner but well-marked. Tertiary venation forms dense network between the secondary veins. Tertiary veins run parallelly with each other and at a right angle to the secondary veins. This dense tertiary vein network is very peculiar and characteristic of the leaf-remains. The tertiary venation is devided by quaternary veins into small polygonal areoles. The leaf-stalk is long with the lamina embracing the stalk. Most of the leaves are fragmentary, but there are some entire ones with a length of about 12 cm and a breadth of about 4 cm. There was found, however, one half lamina, the length of which would have been about 16 cm, and its whole breadth about 8 cm. The rest of the fragmentary leaves also indicate large size.

Locality: Ipolytarnóc, Botos-árok I.

Daphnogene UNGER

Daphnogene cinnamomifolia (BRONG. in CUVIER) UNGER

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Large leaf, length 11.5 cm, breadth 4.2 cm. Lamina slightly obovate. Lamina tapers both at base and at apex, both base and apex are probably acute, but their tips are missing. Leaf margin entire. Midvein thick, with the two basal veins arising asymmetrically. The basal veins are somewhat thinner than the midvein. At about the middle of the lamina a thicker secondary vein arises from the midvein, then farther away, further secondary veins start from the midvein in the apical section. Basal veins run nearly parallelly to the margin. The distance between the midvein and the basal veins is about twice as large as the distance between the basal veins and the margin. The tertiary vein network can be well seen on the whole surface of the lamina. Tertiary veins of unequal length run at obtuse angle in the form of a reversed V between the midvein and the basal veins, and form anastomoses. Between the basal veins and the margin the tertiary venation starts at acute angle, and then curve loop-wise. At the apical section the secondary veins starting from the midvein, also form loop connections.

Note: According to KVAČEK—WALTHER (1974), this species is characteristic of the Oligocene/Miocene boundary. In Hungary it has been found in the Egerian Stage in Vértesszőlős and Verőcemaros (HABLY, 1982). It is also known from the Zsil Valley (Transylvania), and from the Tertiary flora of Habichtswald, Meissner and Siefhennersdorf. According to some authors, it is the shade-grown leaf of *D. lanceolata*, as the two species often occur together. In Ipolytarnóc *D. lanceolata* is absent, unless some narrower leaves referred to as *D. bilinica* can be classified here.

Locality: Ipolytarnóc, Botos-árok I.

Daphnogene cinnamomeifolia (BRONGNIART) BRONN

Pl. IX, Figs. 2, 3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves of medium size elliptical, broad-elliptical. The two basal veins start directly from the base or from a point on the midvein very near the base. There are no stronger veins branching off towards the margin from the basal veins.

Note: Without epidermis analysis it is rather difficult to distinguish among the Daphnogene species. The first description is also rather doubtful as BRONGNIART (in CUVIER, 1822) illustrated only with schematic drawing the remain referred to as *Phyllites cinnamomeifolia*. Strictly observing the morphological description, only a few Daphnogene leaves can be classified here. It is thought to be frequent by NĚMEJC et KNOBLOCH (1973) in the flora of Slovakia. The species lived from the Early Eocene to the Middle Miocene; its territory of extension and life expectancy cannot be stated with certainty as different opinions and taxonomic problems make it difficult to arive at a common decision. It was described by PÁLFALVY (1976b) alongside with *D. bilinica* and *D. lanceolata* from the Middle Miocene sandy andesite tuff in the quarry of Németpatak-völgy near Hont. In this flora the three species are represented in a total of 40 per cent. (*D. lanceolata* has not been found in Ipolytarnóc so far.)

Locality: Botos-árok I., Fehér-hegy.

Daphnogene bilinica (UNGER) KVAČEK et KNOBLOCH

Pl. IX, Figs. 1, 4—5, Pl. X, Figs. 1—7

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves generally small, leathery, elongated elliptical. Base acute, frequently markedly tapering. Leaf apex acute, the more developed leaves show long caudate apices (drip-points). Leaf margin entire. Venation suprabasal, perfect. Basal veins are slightly thinner than the midvein, or of the same thickness. In the basal part of the leaf they run parallel with the margin, in the apical section, where the lamina is getting narrower, they run near the margin. In this section they connect in a loop with a strong vein coming from the midvein. In the apical third of the leaf the secondary veins start from the midvein at gradually decreasing intercostal fields, they form loops, and these loops can be traced as far as the narrowing of the drip-point. The tertiary venation runs more or less horizontally between the midvein and the basal veins, there are anastomoses between them. Tertiary veins run from the basal veins also towards the margin, but they approach the margin not directly, they form loops. Of course there are deviations from the typical and most frequent forms. In most cases the basal vein runs roughly half-way between the midvein and the margin. With leaves of the broader type, however, the distance between the midvein and the basal vein is considerably larger than that, between the margin and the basal vein. In other cases, the lamina narrows abruptly, and thus, the narrow basal section is very short. In several specimens we observed, that the loop-like vein network, starting from the apical third of the leaf, is formed even earlier. The small size of the leaves indicates sun-grown leaves.

Note: According to KVAČEK et WALTHER (1974), *D. bilinica* is characteristic of the Miocene, and occurs mainly in younger Mastixioidea floras. Among its main localities, Bilin is Oligocene, and the more significant localities of the young Mastixioidea flora are Schwandorf, Wiesa, Hradek and Kreuzau. According to KVAČEK et WALTHER (1974), in the Miocene *D. bilinica* and *D. polymorpha* are the dominating species; the latter seems to be a shade-grown leaf. The morphological and anatomical characteristics of the leaves are varied. On a morphological basis alone, the classification of these leaves would be uncertain, but in this case, even the epidermis analysis is inadequate. It is known in Hungary from the Lower Oligocene. Some specimens have been found in the Tard Clay Formation (Hably, 1979). It can be found in prevelant quantity in the Egerian flora of Vértesszőlős (Hably, 1982). It has been found in the Middle Miocene sandy andesite tuff of the quarry in Németpatak-völgy, near the village of Hont (Pálfalvy, 1976b). It is a dominating species also in the Lower Ottnangian formations of Ipolytarnóc. According to Pálfaly (1976a) it constitutes 27 per cent of the flora of the footprint sandstone. From here and from the tuff, it is mentioned both by Jablonszky (1914) and Rásky. *D. bilinica* is an artificial category. The remains of *D. lanceolata* and *D. pannonica* show similarities with *D. bilinica*. In the Ipolytarnóc flora transitory forms have been found, further division is unfounded and superfluous.

Locality: Ipolytarnóc, Botos-árok I—V., Fehér-hegy, footprint sandstone; Borókás-árok, Mogyoróskút.

Daphnogene polymorpha (A. Braun) Ettingshausen

Pl. XI, Figs. 1—4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The leaves are generally medium sized with obovate lamina, i.e. they are the widest at the apical third of the lamina. After tapering, the lamina ends in drip-point. Apex and base acute. Basal veins arise from the midvein at some distance from the base with medium sized leaves at a height of about 0.5 cm, near each other. In the broadening upper third of the lamina stronger veins arise from the midvein and connect with each other. The veins running from the basal lateral veins towards the leaf margin, are generally not strong.

Note: According to Kvaček—Walther (1974), the species is characteristic of the Miocene alongside with *D. bilinica*. As it is rich in morphological variety, it raises numerous taxonomical problems. The above authors suppose that *D. polymorpha* is a shape of a shade-grown leaf, whose sun-grown leaf-equivalent may easily be *D. bilinica*. In Ipolytarnóc *D. bilinica* is present in larger quantities than *D. polymorpha*.

Locality: Ipolytarnóc, Botos-árok I—III., V., Botos-árok, Fehér-hegy.

Daphnogene spectabile (Heer) Knobloch

Pl. XI, Fig. 5, Pl. XII, Figs. 2—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The majority of the leaves are fragmentary, thus their shape cannot be defined with full certainty. The undamaged remains are slightly obovate or elliptical. The leaf base and the apex are acute. The two basal veins start from the midvein above the base, generally at the same, and occasionally at different height. The basal veins generally run at a considerable distance from the midvein, i.e. the distance between the basal vein and the leaf margin is small. In some specimens the basal vein runs in the middle, in these cases the venation, starting towards the margin, is more marked, stronger, and forms a loop network. Between the midvein and the basal veins, the tertiary venation is near horizontal and run parallelly to each other. These veins form a reverse V-shape with widely open lines in the broader sections of the lamina. There are anastomoses between them. In the apical third of the leaf thicker veins start from the midvein as usual with the Daphnogenes. These connect loop-like with the basal veins in consequence of which the resulting venation is camptodromous, brachydodromous.

Comparison: In the Ipolytarnóc flora several large, entiremargined leaves of the Daphnogene type have been found, which we considered identical with *D. spectabile* genus, described by Knobloch (Němejc—Knobloch 1973), and originally described by Heer (1856) as *Cinnamomum spectabile* from the flora of Switzerland. This *D. spectabile* differs from *D. polymorpha* both in size and venation. *D. polymorpha* is nearer to the narrower type, and so to *D. bilinica* and *D. lanceolata*. The venation arising from the basal vein and running towards the margin, is generally much thicker than that of *D. spectabile*, and the whole leaf itself looks more robust than *D. polymorpha*.

Note: *D. spectabile* is known from the Middle European Upper Eocene to the Lower and Middle Miocene. Its most recent occurrence so far is the Bohemian Lower Badenian. According to, Němejc and Knobloch (1973) it is present in relatively large numbers in the Ottnangian flora of Lipovany. Their evaluation, however, does not make their numerical quantity clear, or their percentage in the flora. In Ipolytarnóc it occurs in considerably smaller numbers than the dominating species among the Daphnogene species (Table 2). From an ecological point of view, it is assessed together with the Daphnogene species (Table 3).

Locality: Ipolytarnóc, Botos-árok I—III, V, Fehér-hegy.

Litsea LAMARCK

Litsea ipolytarnocense n. sp.

Pl. XII, Figs. 1, 4, Pl. XIII, Figs. 1—4

Holotype: TTM **82.** 296.1.
Locus typicus: Ipolytarnóc, North-Hungary.
Stratum typicum: Gyulakeszi Rhyolite Tuff Formation, Ottnangian.
Derivatio nominis: after the village Ipolytarnóc.
Material: See in the Hungarian text.

Description: Lamina broad elliptical, suborbiculate, base acute, apex acuminate. The apex rises abruptly, but ends in a relatively short drip-tip. Leaf-margin entire. Venation brachydodromous. In the basal section the venation is completely similar to that of the Daphnogene genus. From the thick midvein into both directions basal veins arise well above the base; they run fairly high, while connecting loop-like with the further secondary veins starting from the midvein.

Comparison: It differs from the Daphnogenes not only in shape but also in venation. While with the Daphnogenes, with the exception of the basal vein, no thicker veins arise from the midvein, unless in the apical third of the lamina, with the *L. ipolytarnocense* a strong secondary venation starts from the midvein equidistantly—one cm from each other—and connects loop-wise near the margin of the leaf. From the basal veins tertiary veins run towards the margin of the leaf and the venation is visible also between the midvein and the basal veins. Occasionally, the Sassafras genus has similar leaf form and venation. The lobeless simple leaves of *S. ferretianum* are very similar to the Ipolytarnóc finds, but it is not probable that in such rich flora and find-assemblage should not have yielded a single trilobate leaf. Although the number of the species, belonging to the Lauraceae, is relatively high in the palaeobotanical literature, the Ipolytarnóc find differs from these very significantly. It can be differentiated from *Sassafras ferretianum* also by differences in venation.

Locality: Ipolytarnóc, Botos-árok I, V.

Laurus LINNÉ

Laurus princeps HEER

Pl. VII, Figs. 2, 3, Pl. XIV, Figs. 1—6, Pl. XV, Figs. 1, 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Lamina elongated elliptical or elongated obovate. Leaf margin entire. Base acute, apex ends in drip-point. The drip-point is marked mainly in the broader elongated obovate leaves, but is visible also in the narrower elongated elliptical forms. Its length is considerable, may be even 2 cm. Venation is extremely marked and conspicuously regular. The secondary veins start from the midvein relatively frequently as equidistant. On the whole, they run parallelly, then connect in loops at a distance of a few mms from the margin, thus forming a brachydodromous venation pattern. This dense, almost parallel and rigid, regular secondary venation is very characteristic of the species. At some places intermediate veins arise from the midvein, these, however, are essentially fainter, and run into the tertiary venation. The tertiary venation forms polygonal areoles. The venation forms new, but considerably thinner small loops between the loops, characteristic of the brachydodromous venation, and at their ends towards the margin. The flora yielded a great number of its impression. It is to be found also in the Lipovany flora of the same age.

Comparison: The finds coming from Lipovany agree with the Ipolytarnóc ones. Drawings made on the basis of the original specimens of HEER, do not, however, show this regularity of the venation. Due to difficulties and uncertainties, well-known in case of the Lauraceae family, the taxon mentioned by HEER as *Laurus princeps* was in 1973 classified among the Laurophyllums, by NĚMEJC et KNOBLOCH. We do not agree with this, since reclassification does not solve taxonomic problems, and even lead to problems in the nomenclature.

Locality: Ipolytarnóc, Botos-árok I. IV, V, Fehér-hegy.

"*Laurus*" *primigenia* UNGER, 1850 sensu WEYLAND 1934

Pl. XV, Figs. 2, 5

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The length of the leaves varies between 7 and 12 cm, their breadth between 2.7 and 3.5 cm. Lamina elongated elliptical, in case of smaller leaves slightly obovate. Base cuneate, apex acute. Venation brachydodromous, secondary veins running at a distance of 1.4—1.6 cm from each other in the median section. In this section they arise at 40—44°. Veins are not rigid, they branch off well before approaching the margin. The angle at which the veins arise and the distance between them are irregular. Leaf margin entire. The remains must belong to the Lauraceae family. They can well be isolated from the other species of the flora.

Locality: Ipolytarnóc, Botos-árok I and "C" locality.

Laurophyllum GOEPPERT

Laurophyllum heeri (ETTINGSHAUSEN) NĚMEJC et KNOBLOCH

Pl. XV, Fig. 3, Pl. XVI, Figs. 1—4, Pl. XVII, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Large-sized leaves with length between 8—12 cm, breadth between 3.5—7 cm. Lamina slightly obovate, elliptical or elongated elliptical. Apex acute, base in many cases asymmetrical. Leaf margin entire. Venation brachydodromous. Midvein thick, secondary veins considerably thinner than the midvein, becoming so thin towards the margin, that their loop-like connection is visible only at thorough examination. No further smaller loop network can be seen on any of the specimens. The distance between the secondary veins in the median section is 1.3 to 2.3 cm, depending on the size of the leaf. At the apex and the base it is less. The veins arise from the midvein at an angle of 30—45°. These data also refer to the median leaf-section. The tertiary venation is visible only occasionally between the secondary veins.

Note: ETTINGSHAUSEN described it from the Tertiary flora of Bilin (1868), NĚMEJC and KNOBLOCH mention it from the Lipovany flora (1973).

In the Natural Science Museum collection there are a few undetermined specimens in addition to the material determined by RÁSKY. Morphologically, the finds are not distinct from each other, but by all probability they were lauriform. As any other evidence is missing, it would be difficult to decide, whether within this it belongs to the Laurus, Litsea, Persea or to other genera. We see no reason for the description of the new species and mainly of the new genus, described by RÁSKY, because the Centroplacus genus, from which RÁSKY derives Centroplacophyllum, is an African genus. The Hungarian Tertiary floras are by no means related to African ones. In our opinion both "species" belong to the Lauraceae family, and can be best identified with *Laurophyllum heeri*.

Locality: Ipolytarnóc, Botos-árok I, V.

Laurophyllum pseudoprinceps WEYLAND et KILPPER

Pl. XVII, Figs. 2, 3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The length of the largest leaf is 10 cm, its breadth is 2.6 cm. Lamina elongated elliptical, base acute, with the tip of the apex broken off, but it can still be seen that it rose abruptly. Base asymmetrical in some places, in others it is symmetrical. Leaf margin entire. Venation camptodromous, brachydodromous. The angle at which the veins arise is 60° to 62° in the apical section, 50° to 55° in the basal section, approaching 60° in some cases. Leaves are leathery. Epidermis analysis was not possible to make, but morphological marks agree with the above species.

Locality: Ipolytarnóc, Botos-árok IV.

Laurophyllum cf. *villense* (WEYLAND et KILPPER) KVAČEK et BŮŽEK

Pl. XVII, Fig. 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Length of the leaf is 7.5 cm, breadth 2.0 cm. Lamina obovate, leaf margin entire. Base acute, the apex is missing. Venation brachydodromous. Midvein marked, secondary veins are thinner, and arise from the midvein rather steeply, at an angle of 22—32°. Secondary veins are connected by a dense tertiary vein network. The distance between the secondary veins is not wholly regular, there may be considerable differences between them. The number of pairs of veins totals 8.

Note: The leaf shows most similarity with the impression, published by KVAČEK (1971), (Pl. 2, Fig. 12), found in the Egerian locality of Markvartice. KVAČEK used epidermis analysis to isolate the species found in the Tertiary of Northern Czechoslovakia, and so morphologically.

Locality: uncertain.

Berberidaceae

Mahonia NUTT.

Mahonia sp.

Pl. XVII, Fig. 5

Material: TTM. **82.** 383.1.

Description: The full length of the leaf may have been about 5 cm, its breadth about 2.2 cm. The apical section and part of the median section are well-preserved, the basal section, however, is twisted into a different plane. Thus, the shape of the lamina cannot be exactly determined, by approximate estimates it was elongated elliptical. The leaf margin is regularly dentate. Apex slightly rounded. Teeth lie under each other in a graded manner, at distances of 0.5; 0.5; 0.5; 1.0 cm from the apex, thus, probably being sparser in the median section. Venation semicraspedodromous, characteristic of Mahonia. The loops formed by the secondary veins cover large areas and run almost as far as the margin. Venation asymmetrical. From the loop-like venation, thick and marked veins run into the tips of the teeth. Between the part of the lamina bordered by the secondary venation and the margin, there is to be found another thin tertiary vein network. The apical sides of the teeth are shorter, straight or slightly convex. The basal sides of the teeth start as slightly convex and then continue vertically in straight sections lasting until the teeth beneath them appear. From the apex the two upper teeth grow out continuously and the apex itself is like a tooth. Not even the midvein runs straight to the apex of the leaf, but breaks where the right-side and the left-side loops meet.

Comparison: We consider the leaf, on the basis of its venation and dentation a Mahonia. It differs from the rest of the fossil Mahonia species in the following: with the majority of the species the teeth are elongated and of serrate appearance. The loops formed by the secondary venation, are generally small, and reach only as far as the middle of the lamina. Thus, between the loops, formed by the secondary veins and the margin, there are further two loop networks formed following each other. This can be observed with the following species: *M. kryshtofovichii* STEF. (TAKHTAYAN 1974, p. 111, Pl. 41, Figs. 1—6, Textfig. 68), *M. heterophylla* and *M. spinulosa* (KOLAKOVSKIJ 1964, p. 59, Pl. 17, Figs. 1—4). The above-mentioned species have highly elongated serrate teeth, but occasionally, less sharp-pointed teeth can be seen besides the serrate ones, even on the same leaf (e.g. *M. heterophylla* and *M. kryshtofovichi*). The Ipolytarnóc find could not be identified with none of these species. Its dentation is very regular with no traces of serrulas, and its venation considerably differs from that of the above fossile species.

Locality: uncertain.

Platanaceae

Platanus LINNÉ

Platanus neptuni (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK

Pl. XVII, Fig. 6, Pl. XVIII, Figs. 1—6, Pl. XIX, Figs. 1—5, Pl. XX, Figs. 1—4, Pl. XXI, Figs. 1—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The size of the leaves varies very widely. The remains being well-preserved, they often appear with stalks, and what is more, full shoot-fragments have remained. The remain listed under the inventory number of TTM **82.** 35.1., demonstrates almost all leaf types. The largest is 10.5 cm long, is at the very end of the shoot, while the smallest, which is 2.5 cm long, is at the base of the shoot. This arrangement creates the impression of a pinnate leaf, although it is not one. The shoot sections between the leaves were lost during the process of fossilization, but the similar position of the leaves can be observed in many cases. The specimens listed under the inventory numbers **82.**

30.1., 32.1., 42.1. in the TTM collection, have a larger leaf in the middle and two smaller leaves under it, on the right and on the left sides (Krenke-formula). At some places the impressions occur in large numbers. Petiolate specimens are very frequent and so it is easy to see that in case of leaves of medium and large sizes, the stalk exceeds 1 cm. The majority of the leaves is asymmetrical. This is shown not only by the base, in many cases the full length of the lamina is divided by the midvein in a conspicuously asymmetrical way (e.g. **82.** 6.1.). Leaves are mostly elongated obovate or elongated elliptical, but never ovate. Base, and sometimes the whole lamina is asymmetrical. Apex and base acute. Venation camptodromous, brachydodromous. In the upper section of the leaf, at about the upper two-thirds, the margin is dentate. Near the base, the leaf margin is always entire. Teeth mostly small, obtuse. The apical side is much shorter than the basal one. The apical side is straight or concave, curving slightly upward, ending in an obtuse tip. The basal side of the tooth is slightly concave, almost parallel with the margin of the leaf. The sinuses are rounded. There is one tooth, starting from the apical side, and making an angle with the sinus, describes a slight S-curve. The teeth of the smaller-sized leaves are weakly developed and smaller. They are the same at the sections nearer the base of the leaf, where they have the same characteristic obtuse tips with rounded sinuses between them. In addition to a great deal of impressions, a pedunculus has been found (probably there were several of them, but it was not recognized during the collection, and no proper attention was devoted to them). Its length is 0.5 cm, breadth 0.3 cm, and its tip characteristically dividing into three parts.

Note: So far, it has been undeterminable in the Ipolytarnóc flora, and has not been published under any other name. In Hungary this is the youngest occurrence of *Platanus neptumi*. A later appearance of it is mentioned in Czechoslovakia (borehole Plesná 146) from the Karpatian (Knobloch et al. 1975). It has been found in dominant quantities from several localities of the Lower Oligocene (Tard Clay Formation) and of the Upper Oligocene (Mány Sandstone Formation, Kovačov Sand Formation) (Hably 1979, 1982). But the Ipolytarnóc flora contains by far the most numerous *Platanus neptuni* impressions ever found to date. The bulk of it was found in outcrop Botos-árok IV. Here it was undoubtedly a dominant species in the Ottnangian.

Knobloch et al. (1975) consider Ipolytarnóc the paratypus locality of Engelhardtia detecta —Laurophyllum div. sp.—Calamus noszkyi zone. Lipovany is considered to be the holotypus locality (more about our opinion on this in the Summary), but *Platanus neptuni* is not mentioned in connection with the characterization of the flora, although it is a dominant species. It has not been found in the Lipovany flora, which contains much fewer species and specimens, and it was not recognized in Ipolytarnóc. Its dominating presence calls for the modification of the flora zone, which we shall do in the floristical assessment.

Locality: Ipolytarnóc, Botos-árok I—II, IV—V, Fehér-hegy and the footprint sandstone.

Fagaceae

Quercus Linné

Quercus apocynophyllum Ettingshausen

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaf highly elongated, obovate. Apex broken off, the original length of the leaf may have been 13 cm, and its breadth 3.3 cm. Base acute. A petiole of 0.7 cm is attached to the lamina. Leaf margin entire. Venation brachydodromous. Midvein thinner than characteristic of this species, in the median third of the lamina the secondary veins arise at an angle of 45—55° from the midvein.

Note: Q. apocynophyllum has been found in the Oligocene and the Miocene in a great number of European localities. In Hungary it has become known from the Kiseged Lower Oligocene as well as from the Upper Oligocene in the Wind brick factory section and the Vértesszőlős localities.

Locality: Ipolytarnóc, Fehér-hegy.

"*Quercus*" *cruciata* A. Braun

Pl. XXII, Figs. 1—4, Pl. XXIII, Figs. 1—4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves large, generally deeply partite, lobate. In most cases there are 3 to 5 pairs of lobes, sometimes fewer. The lobes are very sharppointed and elongated. In most cases also the apex ends in a highly rising lobe. Base attenuate, rounded. Leaf asymmetrical with regards to the lower and the upper sides of the lobes. Midvein thick, strong, end in the apical lobe. Venation craspedodromous. The secondary veins arise from the midvein irregularly, and run into the lobes. Intermediate veins run to the leaf margin, sometimes ending at the margin of the lobes, in other cases connecting loop-like, i.e. brachydodromous characteristics cans be seen. Tertiary venation is at a right angle to the secondary veins, connecting with them. In the case of wider spaces between the tertiary veins, the connections with the secondary veins are almost parallel. The tertiary venation was preserved well in the tuff, and forms a network all over the lamina. Venation of the lobes unusual. From the secondary veins and the midvein, tertiary veins arise at both sides, starting in obtuse angles and thus, not running towards the apex as usual, but on the contrary, they run "backwards". Among them a further, rich, quaternary venation is formed. The leaf margin is always marked, a wide edge of a thickness of about 0.5 mms, similar to that of the midvein, running along and crossing also the lobes. In the negative impressions appears as a groove. This indicates the regular, even, hemlike thickenning of the leaf margin. In some cases, no large lobes had developed, especially with smaller leaves, but attenuate tips formed.

Comparison: "*Quercus*" *cruciata* belongs to a taxonomic group uncertain to date. Kvaček et Walther (1981) subjected those from the European Tertiary section to detailed analysis. Some of them were shown to be Nyssa and Ilex. The majority of the remains, however, still has an uncertain taxonomic position. As a recent equivalent of the plant, the authors mention several Quercus species, such as from the Robur and Cerris sections; and they consider *Quercus undulata* Torr. var. *pungens* Engelh. the equivalent of the leaves found in Ipolytarnóc. It is not easy to decide the ecological demands of "*Quercus*" *cruciata*, as it occurs in floras of different ages and composition. Probably, we have to do not one single species, as indicated by *Nyssa altenburgensis* and *Ilex castelii*, isolated in the course of the epidermis analysis (Kvaček et Walther, 1981). There two species, however, can be distinguished also by morphological characteristics from "*Q.*" *cruciata.* On the basis of its marked morphological characteristics, it can be stated, that all the Ipolytarnóc remains belong to the one and the same species.

Note: It is mentioned in Hungary from the Upper Oligocene by Pálfalvy (1951) and Andreánszky (1966), by the name *Quercus gigantum* Ett., from the Wind brick factory in Eger. A larger quantity from the Lower Miocene was found at Ipolytarnóc, one of the richest locality of this species not only in Hungary but also in Europe. In this country, it is known from the Middle Miocene sandy andesite tuff of the quarry Németpatak-völgy near the village of Hont. Its youngest Hungarian locality is Tállya belonging to the Upper Miocene. It was described by Ettingshausen by the name of *Quercus gigantum.*

Locality: Ipolytarnóc, Botos-árok I—II, IV—V, Fehér-hegy, Mogyoróskút.

Dryophyllum Debey

Dryophyllum furcinerve (Rossmässler) Schmalhausen

Pl. XXIII, Fig. 5, Pl. XXIV, Fig. 2

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves small with length of about 5 cm, and breadth hardly exceeds 1 cm. Lamina very elongated ovate. Base broken off, apex acute, markedly attenuate. Teeth relatively distant from one another, and very characteristic. Venation craspedodromous. Midvein thick, with secondary veins arising from it at both sides, and ending in the tips of the teeth. Secondary veins regular, but not rigid, arising from the midvein at an angle of 45—54°. In the apical section they start out more steeply, and nearer the base, they start out less steeply. Among the secondary veins, a characteristic tertiary venation is formed, connecting the secondary veins. In some cases, in the median section of the lamina—where the leaf is relatively broader and slightly more dentate—not every tooth has a secondary vein running to it, but in some cases Y-like branches start from secondary veins towards the lower teeth. Frequently, a thinner vein branches off from the secondary vein, before it reaches the tooth; this runs upwards, and tapering along, it disappears in the tertiary venation. These characteristics can be observed in many cases.

Extension and comparison: D. furcinerve is a plant, characteristic of the Upper Eocene and mainly of the Lower Oligocene. It is rich in formal variety. It has been described from Europe by different names. In the Palaeogene it occurs mainly together with *Zizyphus zizyphoides* in erothermic assemblages. In Hungary the Lower Oligocene Tard Clay Formation is very rich in Dryophyllum. It can be found at different localities in Budapest (Hably, 1979), as well as in the Kiseged flora, from where it was published by Andreánszky (1964) under the name of *Lithocarpus glabroides*. From the Upper Oligocene (Eger, Wind brick factory), Andreánszky (1966) refers to it as *Castanopsis furcinervis.* From the Hungarian Miocene it has not yet been described. A few specimens can be found, however, in RÁSKY's Ipolytarnóc collection, by the name *Myrica lignitum*, but the finds are totally different from the leaves of *Myrica lignitum*, and even from *Engelhardtia orsbergensis*, which RÁSKY also determined as *Myrica lignitum*. Perhaps it was because of its small size why it failed to be noticed, but under the microscope, on account of its venation and dentation, it is absolutely identical with the remains found in the Tard clay, and with the impressions published in literature.

The flora of the Hungarian Tard Clay Formation contains xeromorphic species. *D. furcinerve* is present in dominating quantities in the xeromorphic assemblages, its ecological optimum being in a more arid climate, or at least, such climate promoted its development into a dominant species. It was not expected to turn up in the Ipolytarnóc flora, where it is only a rare species, anyway. The conditions for its survival were probably given through out the Oligocene, as it still exists in the Egerian flora. It can be considered a relict species in the Ottnangian where the high temperature continued to favour its flourishing, but was supressed by more virulent species. *D. furcinerve* occurs as late as in the Pliocene, thus, being present in the flora of Kodor (Abhazia). Dryophyllum is then not a characteristically Palaeogene genus, though, undoubtedly, it was decaying after the Lower Oligocene. In Europe its last occurrence is known to be from the Miocene.

Locality: Ipolytarnóc, Botos-árok I, IV—V.

Juglandaceae

Engelhardtia LESCHEN et BLUME

Engelhardtia orsbergensis (WESSEL et WEBER) JÄHNICHEN—MAI—WALTHER

Pl. XX, Fig. 5, Pl. XXIV, Figs. 3—6, Pl. XXV, Figs. 1—8, Pl. XXVI. Figs. 1—6, Pl. XXVII, Fig. 5

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: In the Ipolytarnóc flora not only leaflet impressions are frequent; in many cases the whole leaf has been preserved or, at least, a greater part of it. The length of an entirely preserved rachis is 12 cm. On some impressions 11 to 13 leaflets, belonging to the same leaf, are visible, these, however, are rarity also here. Most frequently 2—3 leaflets remained together. The bulk of the remains, of course, consists of single leaflets of different sizes. As it can be seen on the relatively entire leaves, the length of the leaflets decreases from the base to the apex. The measurable longest leaf was 6.1 cm, the smallest 1.7 cm. The most frequent lengths are about 3, 4, 5 cm. The leaflets are elongated or very elongated ovate. They are the broadest in the basal third of the leaf, their breadth varying most frequently from about 0.6, 0.7 to 0.8 cm. The narrowest leaflet is 0.3 cm, the broadest is 1.6 cm. The teeth of the leaflets are very characteristic. The small sharp teeth show a slightly outward curve. The apices of the teeth are acute. The distance between them is generally great. The apices of the leaflets are acute and they also taper towards the base. The base is generally asymmetrical. Venation camptodromous, brachydodromous, with the secondary veins arranged relatively densely. In every tooth one vein ends.

Note: Engelhardtia is known from the Middle Eocene in Hungary. A comprehensive study on the stratigraphical, ecological and cenological role of these species has been published by PÁLFALVY (1981, pp. 491—495). It is mentioned from the Kiseged flora by ANDREÁNSZKY and NOVÁK (1957), by ANDREÁNSZKY (1963) by the name *Schinus oligocenicum*. It was detected by HABLY, by means of epidermis analysis in the Kiscell 1 borehole in Budapest. It is present, however, in the Lower Oligocene in small numbers, with uncertain data at our disposal from the Upper Oligocene. It appears suddenly in large quantities in the Ipolytarnóc flora, where it is one of the dominating species, even if we consider that we have to do with leaflets, and the number of whole leaves is apparently smaller. From here it was mentioned by RÁSKY (1959) by the name *Myrica lignitum*. From the Middle Miocene PÁLFALVY (1981) published Engelhardtia remains from the area of Magyaregregy and Eger-Tihamér fields. From the Sarmatian it is mentioned by ANDREÁNSZKY as *Schinus molle* from Erdőbénye (1959). Here, however, it is present in very small quantities, and it had no considerable role to play then in the composition of the flora.

Locality: Ipolytarnóc, Botos-árok I—VI, Fehér-hegy, Borókás-árok I, Csapás-völgy, Mogyorós-kút and the footprint sandstone.

Cyclocarya cyclocarpa (SCHLECHTENDAL) KNOBLOCH

Pl. XXIV, Fig. 1, Pl. XXVII. Figs. 1—5, Pl. XXVIII. Figs. 1—5

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The leaflets are generally small, the maximum length is 7.0 cm, minimum length 2.6 cm. Maximum breadth 2.6 cm, minimum breadth 1.1 cm. The most frequent is a leaflet of about 4—5 cm in length, and 1.5—1.8 cm in breadth. The leaflets are asymmetrical, elliptical, oblong or slightly ovate. Apex acute, lamina tapering towards the base. Venation camptodromous. Distance between teeth large, teeth small, they are not fitting to the lamina, in spite of their small size, they show a definite curve away from the margin. Their apical side is straight, the basal one is either straight or slightly convex. There are no angles between the teeth, because they are not close to each other, and there are straight lamina sections with entire margin between them. The teeth can be seen well only on wholly entire specimens. In very many cases the ends of the teeth are broken off, or buried by the rolled-up leaf. The veins branch to the teeth from the loop-like sections of the brachydodromous venation. Each loop gives off vein sections to 2—3 teeth. The formation of loop network, i.e. the further looping of the brachydodromous venation, is not as characteristic as it is with the *P. paradisiaca*, in many cases it does not exist, at all. In the area bordered by the loops there is a network of further veins, also connecting the secondary veins.

Comparison: C. cyclocarpa venation is camptodromous, but it is different from *Pterocarya paradisiaca* venation. In *P. paradisiaca*, the secondary veins arise from the midvein at larger distances from each other, thus the loops surround larger areas. The most essential difference between the two species, can be seen in the teeth. The teeth of *P. paradisiaca* are more densely arranged, they follow tightly each other, the ends of the teeth are obtuse. The teeth of *C. cyclocarpa* are much more sparsely arranged.

Note: No fruit of *C. cyclocarpa* has been found in the flora. It is not clear yet, what fruit-impression belongs to this leaf. KNOBLOCH (NĚMEJC—KNOBLOCH, 1973) described the Lipovany finds identical with the Ipolytarnóc ones, under the name of *C. cyclocarpa;* here only two fragmentary leaflets have been found.

In Ipolytarnóc this species is present in large quantities and, thus, it is regarded as dominating here. In Hungary it has been found, so far, only in Ipolytarnóc, and described as *Hicoria bilinica* (JABLONSZKY, 1914) and *Pterocarya denticulata* (RÁSKY, 1959). In Europe relatively few localities have yielded this species, and only from the Oligocene—Miocene boundary zone. According to KNOBLOCH (NĚMEJC—KNOBLOCH, 1973), it is characteristic of the Upper Oligocene and the Lower Miocene.

Locality: Ipolytarnóc, Botos-árok I—II, IV—V, Borókás-árok, Csapás-völgy, Mogyoróskút and the footprint sandstone.

Carya NUTT.

Carya bratkoi n. sp.

Pl. XXVIII, Fig. 6, Pl. XXIX, Fig. 4, Pl. XXXVI, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaflets markedly elongated obovate. The greatest length of the lamina is in the upper quarter. The length of the leaves varies between 3.5 and 9.6 cm, their breadth ranging from 1.6 to 3.9 cm. The small-sized leaflets are less numerous. The length of about 9 cm, and breadth of about 3 cm, are more general. The majority of the leaves being of this size. The lamina tapers more markedly towards the base than towards the apex. The apex rises abruptly, cuneate, base markedly attenuate, acute. Lamina more or less symmetrical, base slightly asymmetrical. Leaf margin toothed. Teeth markedly larger near the apex than near the base. Apex of the teeth acute, their apical side concave or straight, basal side mostly concave and, occasionally, convex. Distance between teeth not wholly regular, sinuses between them generally rounded. Teeth make obtuse angles. In the basal part of the leaf, teeth very weakly developed; prickle- or splintlike projections. Venation camptodromous. Distance between secondary veins largest in the median section: 1.1—1.0 cm. From the arched curves of the secondary veins, small vein-section branch off to the teeth. From the midvein arise also hardly visible intermediate veins, between the secondary veins. The tertiary vein network runs at a right angle to the secondary veins. Several remains fossilized near each other, are positioned in such an angle, that it is apparent, that they are the leaflets of a compound leaf. This is indicated also by the asymmetry of the base.

Comparison: The species differs from *C. denticulata* (WEB.) ILJ., *C. serraefolia* (GOEPP.) KRÄUSEL and *C. cordioides* ILJ. species also in shape and dentation. In all the three species the length/breadth ratio is smaller than in *C. bartkoi*. Neither has as narrow, long-tapering bases and attenuated apex as *C. bartkoi* has. Generally, there are no teeth in the basal section, while *C. bartkoi* has weakly developed teeth, and its teeth are much more varied and differentiated than those of the above three species. The caudated long apex of *C. bartkoi* indicates a probability of a humid climate.

Locality: Ipolytarnóc, Botos-árok V.

Myricaceae

Myrica LINNÉ

"*Myrica*" *hakeaefolia* (UNGER) SAPORTA sensu ENGELHARDT

Pl. XXXI, Figs. 3, 5

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Length of leaves about 4.3—5.3 cm, breadth 1.3—0.9 cm. Lamina lanceolate, apex and base acute. Venation camptodromous-craspedodromous. Leaf margin toothed, teeth large, relatively unfrequent. The apices of the teeth acute, and slightly curves like a claw. The sinuses between the teeth are rounded, and there is a slightly elongated S-curve between them. Base hardly tapering, with entire leaf margin in this part. Midvein marked, secondary veins run into the teeth at angles of about 30° to 35°. Between the secondary veins, there is a dense tertiary vein network, form at a right angle; the areas formed by the tertiary veins, are devided by quaternary veins also at right angles to the tertiary ones.

Note: The taxonomic status of *M. hakeaefolia* is rather uncertain. In addition to the descriptions of UNGER and SAPORTA, we have HEER's (1856) description of *Dryandroides hakeaefolia.* Not all the figured remains are surely belonging to the one and the same species. It was published from the Egerian Stage of the Bohemian massive by BŮŽEK—HOLÝ—KVAČEK (1976), and from the flora of Markvartice and Kundratice by BŮŽEK—KVAČEK—WALTHER (1978). This species is known in Hungary from the Lower Oligocene. In Ipolytarnóc, the small number of the taxa indicates only sporadic presence.

Locality: Ipolytarnóc, Fehér-hegy, Borókás-árok.

Ebenaceae

Diospyros LINNÉ

Diospyros brachysepala A. BRAUN

Pl. XXIX, Figs. 1—2, 6

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves elliptical or elongated elliptical. Length 4.0—6.3 cm, breadth 2.5—3.0 cm. Many leaves have stalks. Leaf margin entire, base cuneate, apex in most cases fragmentary, on the entire leaf acute. Venation brachydodromous. Depending on the size of the leaf, the secondary veins arise from the midvein at distances 0.5 to 1.0 cm. The secondary veins are thinner than the midvein, the whole surface of the lamina is devided into tiny polygonal areoles by a rich tertiary and quaternary vein network. Occasionally, there are intermediate veins between the secondary veins.

Note and comparison: The species is not rare, but neither is it characteristic in the European Tertiary Period. In Hungary it has been found also in the Sarmatian (ANDREÁNSZKY, 1959). It is mentioned by NĚMEJC—KNOBLOCH (1973) from the Lipovany flora. On the basis of the figure published, we do not consider it probable that this specimen belongs to the *D. brachysepala* species. Its leaves are broader, and also its venation is different.

Locality: Ipolytarnóc, Botos-árok I and uncertain locality.

cf. *Diospyros rugosa* SAPORTA

Pl. XXIX, Figs. 7—9

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: From the Ipolytarnóc flora RÁSKY has already published a few flower impressions called *Diospyros rugosa,* and having a diameter of about 1.2—1.3 cm. The flower consists of five petals, the calyx narrows inwards conically. It is gamopetalous, between the petals a margin is well visible. A similar impression can be found in the collection also under the name *Antholithus* sp., which has a diameter of about 1.0 cm, and it is also quinquepetalous. The calyx conically narrows inwards. There is another similar undefined impression in the collection of the Hungarian Geological Institute, with a diameter of only about 0.5 cm, much smaller than the previous ones. The flower looks sexpetalous, though it is possible that the poorer preservation of one of the petals is responsible for this. The centre of the flower shows the same formation as the previous ones. Being a positive impression, here the conical centre of the flower forms a relief, and also the margin connecting the petals is well visible.

Comparison: Similar remains are mentioned in the literature mainly by the name Diospyros. Remains were published by SAPORTA (1862) under the name *Diospyros rugosa*, and by HEER (1859) under the name *D. brachysepala;* these, however, are made up of four gamopetals. Also described by HEER were quinquepetalous flowers under the name *Porane oehningensis*, and quadripetalous ones, under the name *Cornus ungeri*. ETTINGSHAUSEN (1869) published flower impressions from the Bilin flora under the name *D. paradisiaca* and *D. bilinica*. The definition of the flowers is rather uncertain since the most important characteristics, e.g. stamens, stigma are not visible in them. RÁSKY (1964) described the remains found at Tállya and Ipolytarnóc, under the name *D. rugosa*, which taxonomy we shall be using although we know the above mentioned uncertainties. Flower impressions of this type, however, are significantly different from the Abelia remains, described from the Lower Oligocene, and they mostly appear in the Miocene floras.

Locality: Ipolytarnóc, uncertain locality.

Elaeocarpaceae

Elaeocarpus LINNÉ

Elaeocarpus palaeolanceolatus KOLAKOVSKIY

Pl. XXX, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Length of leaf 5.8 cm, breadth 1.8 cm. Lamina elongated elliptical. Apex and base acute. Venation brachydodromous. Midvein tapering towards the apex. Secondary veins thin, arising from the midvein in the median third, at an angle of about 40°. Above the secondary loops, there are further smaller loops. There are only one or two very thin teeth on the leaf margin. The distance between them is 0.5—0.6 cm. They are arranged irregularly. On one side of the leaf there are three teeth, on the other there is only one. All of them are in the upper median section. The teeth are extraordinarily small, their apices mucronulate, and their axes steeply rising.

Comparison and note: The remains agrees with the species, described by KOLAKOVSKIY (1964), found in the Pliocene flora of Kodor. It is mentioned by ANDREÁNSZKY (1966) from the Upper Oligocene of the Wind brick factory. It may be present in the Ipolytarnóc flora in larger quantities, but only entire specimens can be recognized on account of the sparse and small dentation.

Locality: Ipolytarnóc, Botos-árok I.

Rosaceae

Spiraea LINNÉ

Spiraea sp. 1

Pl. XXX, Figs. 2—6

Material: TTM. **82.** 220—221. l., 229—232. l.

Description: Leaves are small, their length not reaching 3 cm, and their breadth hardly exceeding 1 cm. Lamina elliptical. Both leaf apex and base acute, margin toothed. Apex of teeth mucronulate, their apical side straight or slightly concave, basal side convex. Sinuses between the teeth slightly rounded. Venation brachydodromous. Midvein marked, secondary veins arising frequently from the midvein, and connecting with each other loop-like near the margin. Between the secondary veins, also intermediate veins arise from the midvein, which end in the dense tertiary vein network. Between the loops, formed by the secondary veins, there are new loops formed, which arch over the angles of the loops. Generally, from each of these loops, formed by the secondary veins, a thin vein starts towards each of the teeth.

Comparison: The leaves resemble the characteristics of the Rosaceae family, but their teeth are essentially different from those peculiar to the Rosa genus. In the Tertiary, Spiraea species can be found in several places, but their taxonomic status is rather uncertain. Generally, they are found in small numbers, often represented by one or two impressions. KNOBLOCH (1969) described a find from the Moravian basin, under the name *Spiraea* aff. *vetusta;* this, however, is completely different from the Ipolytarnóc find. KRISTOFOVICS and BAIKOVSKAYA (1965) mention an undefined Spiraea find from the flora of Krynka, which also differs from the one, found here. The finds, published by ANDREÁNSZKY (1959) under the names *Spiraea* cfr. *tomentosa* and *Spiraea* cfr. *triloba* and described from the Sarmatian flora of Bánhorváti and Balaton villages, are also different. ZHILIN (1974) describes Spiraea finds from the Lower Miocene strata of Kuenyak (near Lake Aral), whose venation differs also considerably from that of the Ipolytarnóc remains.

Locality: Ipolytarnóc, Botos-árok V.

Spiraea sp. 2

Pl. XXX, Fig. 7

Material: TTM. **82.** 236.1.

Description: Lamina ovate. Length 1.9 cm, breadth 1 cm. Apex acute, base slightly asymmetrical, cordate. Venation well visible. Midvein marked, secondary veins arising at relatively large distances from one another: from 0.4 to 0.45 cm. The angle at which the veins arise, is about 50°. The tertiary venation between the intermediate and the secondary veins, forms polygonal areoles. Leaf margin dentate, teeth sharppointed, with the apices of the teeth getting more and more mucronulate towards the leaf apex. In the basal section the teeth are more numerous. *Spiraea* sp. 2. differs from *Spiraea* sp. 1. not only in its shape, but also in its venation.

Comparison: There was only one specimen found in Ipolytarnóc, its taxonomical status is rather uncertain. On the basis of its small size, dentate margin and brachydodromous venation, it is classified in the Rosaceae family. The teeth are very different from those of the Rosa genus. It can best be related to the Spiraea genus.

Locality: Ipolytarnóc, Botos-árok V.

Caesalpiniaceae

Cassia LINNÉ

Cassia hyperborea UNGER

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Length of leaflets 6.8—9 cm, their breadth varying between 1.8 and 3 cm; they have short petiolules. They are ovate, with acute bases and apices, the latter being very attenuate. Midvein marked, venation brachydodromous. Several leaflets have been preserved near each other, along the rachis. At the end of the rachis, the place, where the two leaflet-petiolules connect, is visible, which means, that the leaf was abruptly pinnate compound leaf.

Comparison and note: The species has been described from the Miocene flora of Sotzka (UNGER, 1850), Switzerland (HEER, 1859) and Znojmo (KNOBLOCH, 1969). At Ipolytarnóc, a relatively small number of remains was found, but this find is remarkable, being the first, described with rachis. The legume, described from the flora of the footprint sandstone as *Leguminocarpon pachyrhisoides* (RÁSKY, 1964), may belong to this species, but there is no evidence to prove the connection between the fruit and the leaf.

Locality: Ipolytarnóc, Botos-árok I.

Cassia stenophylla HEER

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Abruptly pinnate compound leaf. Four leaflets of the upper section of the leaf have been preserved. The rachis and the leaflets, attached to it by short petiolule, are well visible. The length of the leaflets is about 2.3 cm, their breadth about 0.5 cm. Their shape is elongated ovate. Both the base and the apex are acute, and the apex is well attenuate. The midvein is thick and marked, but the secondary veins are not visible. 2 cm away from the leaf-fragment, an independent leaflet has been preserved. This, however, is larger than the previous ones, with a length of 3.5 cm and a breadth of 1.5 cm. The leaflet is also ovate with a mucronulate apex. It had probably been detached from the lower section of the leaf. On this specimen the venation is better visible. The venation is camptodromous, without regular loops being formed. The secondary veins become thinner where the loops are formed, and run into the anastomosing tertiary venation.

Comparison: The highly attenuate apex makes it very different from Podogonium. It is the most similar to *C. stenophylla* described by HEER, from the Miocene flora of Switzerland.
Locality: Ipolytarnóc, uncertain locality.

Podogonium HEER

Podogonium oehningense (KOENIG) KIRCHHEIMER

Pl. XXXI, Figs. 2, 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Only one single fragment with 6 leaflets, and a few leaflets have been preserved in the Ipolytarnóc tuff. Although the leaf is fragmentary, the distance between the leaflets, and their position in relation to each other are well visible. Leaflets are slightly elongated elliptical, with round bases. They are attached to the rachis by short petiolules of about 0.15 cm. The apices of the leaflets are obtuse. The lamina tapers towards the apex but ends obtusely. The midveins of the leaflets are thick, with weak, thin and dense venation arising from them, and seemingly running straight to the margin, but magnifying lense makes it well visible that occasionally they form loop-like connections. Between the secondary veins, also some very weak intermediate veins arise from the midvein, which form multiple anastomoses with each other and with the secondary veins. The leaflets are arranged at distances of 0.7, 0.8, 0.8, 0.8 cm from each other. On the rachis the stigmas of the petiolules of the fallen leaflets are visible. The lower leaflets are smaller than the apical ones.
Note: From Hungary it was first mentioned by ETTINGSHAUSEN (1853), from the Sarmatian beds of Tállya, by the name *Cassia pannonica*. From the same locality it was described by KOVÁTS (1856) by the name *Copaifera longestipitata*. PÁLFALVY (1953, 1961) mentions it from the Karpatian layers of Magyaregregy, and the Badenian layers of Szurdokpüspöki; ANDREÁNSZKY collected the finds from the Sarmatian flora. In Hungary, the Podogonium lived from the Karpatian to the Sarmatian, its richest locality being Szurdokpüspöki. According to the Early Ottnangian find at Ipolytarnóc, Podogonium was present already in the Early Miocene, although only sporadically. It became widespread only later, when climatic conditions became unfavourable for other, hygrophytic species. At the end of the Miocene, the genus became extinct in the Hungarian flora.
Locality: Ipolytarnóc, Fehér-hegy.

Leguminocarpos RÁSKY

Leguminocarpos pachyrhizoides RÁSKY

Pl. XXXI, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 72.
Locality: The fruit impression has been found in the footprint sandstone.

Schisandraceae
Kadsura KAEMPF. ex JUSS

Kadsura protowightiana RÁSKY

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 456.
Locality: Ipolytarnóc, Botos-árok IV.

Thymelaeaceae
Daphne LINNÉ

Daphne oehningensis (A. BRAUN) WEYLAND

Pl. XXXII, Figs. 1—4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The leaflets are small, their shape is obovate. The apex is rounded, and towards the base from the apex the breadth of the leaf quickly decreases, thus, the base tapers long, and is cuneate. The leaf margin is entire, only the midvein is marked, no further venation is well visible on any of the specimens. The preservation indicates leathery leaf.

Note: The species was first described by BRAUN (1851) from the flora of Oehningen, and by HEER (1856) from the Tertiary flora of Switzerland by the name *Pimelea oehningensis.* It was re-named by WEYLAND (1938) as *Daphnogene oehningensis*, because the Pimelea lives in the southern hemisphere, and probably it did not live in the North, even in the Tertiary. The species is described as *Ledum limnophyllum* from the flora of Parschlug by UNGER (1856). This is revised by KRISTOFOVICS and BAIKOVSKAYA in connection with the finds from the flora of Krynka. Similar impressions were published under the name *Rhus heufleri* by HEER (1859, Pl. 177, Figs. 3—5). It is mentioned by KNOBLOCH (1969) as *Daphne* aff. *giraldi* NITSCHE from the Tertiary flora of the Moravian basin, but he publishes some remains undefined, under the name Dicotylophyllum from Znojmo (Pl. 12. Figs. 3—5.); these are probably also Daphne remains. ZASTAWNIAK (1980) publishes one single small specimen from the Sarmatian flora of the Holy Cross Mountains.

Locality: Ipolytarnóc, Botos-árok IV—V.

Myrtaceae

Myrtophyllum SCHMALHAUSEN

Myrtophyllum sp.

Pl. XXXII, Figs. 5—7

Material: See in the Hungarian text

Description: The leaves are small with length between 1.6 and 5.2 cm, their breadth varying from 0.6 to 1.4 cm. The rest of the leaves are fragmentary, but approximately within the same dimension. The leaves are very elongated, slightly obovate or elliptical. The base is acute, the lamina tapers long towards the base and it does also towards the apex, which in some cases emarginate. The leaf margin is entire. The venation is brachydodromous but in a very special way. The midvein is marked with thinner secondary veins arising from it, not very steeply, but rather horizontally. The secondary veins form loops with one another near the margin of the leaf. The loops are angular, thus, producing a definite line parallelly with the margin at a distance of 0.5—0.8 mm from it.

Comparison: This very regular venation and the formation of a line, parallel with the margin, occurs, for example, with the *Buxus pliocenica* species (ZASTAWNIAK, 1980). The leaf shape and venation of this species are totally different. *Buxus pliocenica* has a very dense venation, which branches off in Y-shape near the margin. The venation of *Callistemophyllum hungaricum* CZIFFERY shows some similarities with that of the Ipolytarnóc remains, but the leaf is very elongated obovate, the base is rounded, thus, differing totally from the above find. It shows the closest resemblance to the remains described as *Myrtophyllum* sp. by AVAKOV (1979), yielded by the Miocene flora of Medtshud (Gruziya). Its preservation indicates leathery leaf.

Locality: Ipolytarnóc, Botos-árok II, V, Fehér-hegy.

Aceraceae

Acer LINNÉ

Acer tricuspidatum BRONN

Pl. XXXIII, Figs. 1—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: A few leaf fragments and one fruit were found in Ipolytarnóc. The leaves are small, trilobate. The length of the best preserved leaf is about 3.2 cm, equal to the length of the median lobe. The length of the lateral lobes is 2.5 cm. The median lobe is not only longer, but also broader than the two lateral ones. The midvein and the two veins running into the lateral lobes make an angle of 43° and 42°, respectively. Stronger secondary veins arise from the midvein only in the upper half of the leaf, roughly at the area where the median lobe is definitely separated from the lateral lobes. These veins form loops brachydodromously, but they branch off towards the leaf margin. The venation is actually actinodromous. The margin is irregularly dentate; the veins end in these teeth. From the midveins of the lateral lobes, there are veins branching off towards the teeth. The leaf apex is acute, like those of the two other lobes. The base is rounded. Both wings of the samara are preserved. The samara is small, one wing is about 2.0 cm long. The two wings are near each other, making an angle of about 50°.

Note: The species lived in Central-Europe from the Late Oligocene to the Pliocene, considered to be most frequent in the Miocene (WALTHER, 1972). It appears in several morphological variations. In some Miocene localities it is present in great quantities (HANTKE, 1965). In Ipolytarnóc a few specimens of it have been found.

Locality: Ipolytarnóc, Botos-árok.

Araliaceae

Oreopanax DENCE et PLANCH

Oreopanax protomulticaulis (RÁSKY) n. comb.

Pl. XXXIII, Fig. 4, Pl. XXXIV, Figs. 1—3, Pl. XXXV, Fig. 4

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves are large with a length of 8—13 cm and breadth varying between 3 and 6 cm. They are elongated, slightly obovate or elliptical. Venation brachydodromous, base cuneate, apex acute. Along the margin, there are large, obtuse teeth, at great distances from each other. Both the apical and the basal sides of the teeth are convex. Being arranged at great distances from one another, the teeth do not make angles. The midvein is thick and marked, usually reaching 1 mm, and in the basal section of the larger leaves coming near to 2 mm. Secondary veins are thin but very marked. There are 6—8 pairs of veins in the leaves. They arise at angles of 40° in the basal third; 45—50° in the median third; 60—45° in the apical third of the lamina. The distance between the veins varies according to the size of the leaf. With the smaller leaves it is 0.9—1.2 cm in the median third, whereas with the larger, broader leaves, the veins arise at distances between 1.2—1.7 cm. Beside and above the loops, formed by the secondary veins, a small loop network is formed. Not each secondary vein runs into a tooth, the teeth being sparse. The first pair of secondary veins, nearest the base, arises from the midvein in a characteristic way; these are considerably thinner than the secondary veins starting in the median and in the apical third. At the base they run very near the midvein and parallelly with it. The separate vein bunch is well visible, arising at acute angle, steeper and less abruptly than the secondary veins above it. Above this vein the next pair of secondary veins arise at a very great distance, and thus the vein, looping backwards, borders a considerably larger surface than the rest of the secondary veins. The secondary veins, starting in the median third, show a break or small curve before connecting with the midvein.

Comparison: On the basis of a basal fragment, RÁSKY (1959) described this species under the name *Schefflera protomulticaulis*. The basal section is really very characteristic, not revealing, however, the other important marks of the leaf. The large, distant teeth, the brachydodromous venation and the spacing of the basal venation are characteristic of the Orenopanax genus. *Orenopanax crassinervium* DENCE et PLANCH often has in the lower section of the shoot sparsely and coarsely dentate leaves, similar to our find. The leaves of this recent species, however, are very varied. They may be simple, entire-margined, with sparse and coarse teeth, dense mucronulate teeth; trilobate leaves are also frequent. SAPORTA (1863) mentions an impression from the Oligocene of South France by the name *Aralia (Orenopanax) coelestis*, having very similar venation, but entire margin.

Locality: Ipolytarnóc, Botos-árok I.

Schefflera FORSTER

Schefflera gaudini (SAPORTA) RÁSKY

Pl. XXXI, Fig. 3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 458.

Locality: Ipolytarnóc, uncertain locality.

Schefflera protolucescens RÁSKY

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See RÁSKY 1959, p. 459.

Locality: Ipolytarnóc, Botos-árok I.

Rubiaceae
Tricalysa A. Rich

Tricalysa protojavanica Rásky

List of synonym, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See Rásky 1959, p. 460.
Locality: Ipolytarnóc, Botos-árok I.

Flacourtiaceae
Erythrospermophyllum Rásky

Erythrospermophyllum ipolytarnocense Rásky

List of synonym, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See Rásky 1965, p. 82.
Locality: Ipolytarnóc, uncertain locality.

Ericaceae
Andromeda Linné

aff. *Andromeda* sp.
Pl. XXXIV, Fig. 4

Material: MÁFI 228

Description: The length of the leaf is 1.8 cm, its breadth is 0.8 cm. Base asymmetrical, acute. Apex slightly fragmentary, also acute. Lamina elliptical-ovate, leaf margin entire. Venation brachydodromous. Midvein thick, the secondary veins arising from it are also marked, well visible as they form loops with each other. There are intermediate veins arising between the secondary veins, which are thinner than the secondary veins. These connect in loops with the secondary veins under them. The tertiary vein network between the secondary and the intermediate veins is weak and only its traces remain. Above the loops formed by the secondary veins, there are further small loops near the leaf margin.

Comparison: The impression is most similar to the *Phyllites* sp. 10. specimen found by Avakov (1979) in the Miocene flora of Medshud (Gruziya). This leaf is also small, asymmetrical with entire margin and brachydodromous venation. Though its exact taxonomic status has not been defined, the author lists it among the Myrtoid leaves, alongside with several other small-size leaves. Similar leaves are described by Zastawniak (1980) under the name "*Anagyris foetida*" from the Miocene of the Holy Cross Mountains. This leaf, however, is asymmetrical, its shape is elongated elliptical, base is cuneate. Similarly small-size leaf with brachydodromous venation and entire margin is published by Kolakovskiy and Schakryl (1976) from the Sarmatian flora of Abhazia, under the name *Vaccinium protoarctostaphyllos*, which, however, cannot be related to the Ipolytarnóc find. A similar find from the Lipovany flora is the aff. *Andromeda* sp. with a slightly different leaf form (Němejc et Knobloch 1973). Numerous similar finds were mentioned by Heer (1859) from the Tertiary flora of Switzerland, under different names. Among them there was an ovate one, mentioned as *A. vaccinifolia*, but also *Vaccinium acheronticum* is similarly elliptical and slightly ovate. It was difficult to determine this leaf, because it is small and lacks special characteristics. Its venation reminds us even of Diospyros, but here we have to do mainly with larger leaves. Considering the above facts, taxonomically it probably belongs to the Ericaceae family. This seems to be plausible on morphological basis, but regarding the ecological demand of the family, it is doubtful. One single impression does not change too much our image of the flora and the climate.

Locality: Ipolytarnóc, uncertain locality.

Smilax weberi WESSEL

Pl. XXXV, Figs. 1, 2, Pl. XXXVI, Fig. 2

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves ovate, apex acute, base may be formed in two different ways; with larger leaves it is broad cordate, with smaller ones it is acute or truncate. The leaves are small. The largest being about 9 cm long and 7 cm wide, but the majority of the remains are smaller than that. The leaf margins are entire, and the venation is campylodromous. The primary venation consists of 5—7 veins with 5 in narrow leaves, and 7 in those having cordate bases. The midvein is relatively thick, the rest of the primary veins are relatively thin. There are differences even here; the vein running nearest the margin, is the thinnest. There is a dense, irregularly branched vein network formed between the primary veins, which all run into the apex.

Note: The species was first described from the Miocene by UNGER, from the Radoboj flora, without mention being made of recent relations. It was listed by HEER (1855) from the flora of Switzerland definitely among the Smilacaceae. Recently it was mentioned from the Miocene of the Bohemian Basin by BŮŽEK (1971) as well as KNOBLOCH and KVAČEK (1976). From the Middle Miocene of Denmark (Søby flora) a great number of *Smilax weberi* finds were published by CHRISTENSEN (1975), who, through detailed epidermis analysis came to the conclusion that *S. weberi* was not to be related to any Smilax species living at the present day. According to him, it is nearer in relation to *S. hispida* and *S. excelsa*, the former living in the South—East of North America, the latter in East Europe and Central Asia. *S. weberi*, however, differs from both in several details. In a preliminary report published by RÁSKY in 1959, three Smilax species are mentioned: *S. obtusifolia* HEER, *S. franklini* HEER and *Smilax* sp. div. These, however, have not been described in detail from Ipolytarnóc, neither are these species named in the RÁSKY collection.

Locality: Ipolytarnóc, Botos-árok II, V.

Smilax aspera L. (fossilis)

Pl. XXXVI, Fig. 1

Material: KFM. **56.** 94.3.

Description: Lamina ovate, its length 6.7 cm, breadth 3.3 cm. At the basal third, the lamina broadens a cordate base. The end of the apex is broken off. Venation campylodromous. The midvein and the two primary veins running along its two sides, are marked. The primary veins do not run straight to the apex. In the apical third of the lamina, where further veins arise from the primary veins, there are contractions. There is a thin, hardly visible pair of vein, running to the base of the lamina, which has densely arranged, thorn-like teeth, very small, of a length of maximum 0.5 mm.

Comparison and note: The morphological characteristics of the leaf indicate equivalence with the recent species of *Smilax aspera* L. As a fossil, it is mentioned by KOLAKOVSKIY (1964) from the Pliocene flora of Kodor, by KOLAKOVSKIY and SCHAKRYL (1976) from the Sarmatian flora of Sibok. ANDREÁNSZKY (1959) mentions one *Smilax praeaspera* from the Sarmatian flora of Buják, the venation of which, however, differs from the aspera. The Ipolytarnóc find shows the closest resemblance to the narrow-leafed species found in the Kodor flora.

Locality: Ipolytarnóc, Botos-árok.

Smilax borsodensis ANDREÁNSZKY

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: The length of the larger leaf is 3.9 cm, its breadth is 4.1 cm, and it is almost rounded. Leaf margin entire. Venation campylodromous. There are five veins starting from the base, i.e. the midvein running to the apex, and the two pairs of veins. The apex is slightly fragmentary, base broad, cordate.

Comparison: The impression shows a considerable morphological difference from *S. weberi*. The specimen from Szécsény is slightly fragmentary, but its shape shows closest resemblance to *S. borsodensis*. This species was described by ANDREÁNSZKY, from the Hungarian Sarmatian.

Locality: Ipolytarnóc, Botos-árok I.

Smilax sp.

Material: KFM. **61.** 981.1.

Description: The length of the leaf was probably about 2.5 cm with a breadth of 1.5 cm. The apex is missing, the base is relatively well-preserved, thus, the broadening base, characteristic of the Smilax species, is clearly visible. There are two thick primary veins running along the midvein. The vein, running towards the base, is hardly visible. The leaf margin is fragmentary. The poor preservation makes reference to specific entity impossible.
Locality: Ipolytarnóc, Botos-árok.

Arecaceae
Calamus LINNÉ

Calamus noszkyi JABLONSZKY

Pl. XXXV, Fig. 3, Pl. XXXVI, Figs. 3, 5, Pl. XXXVII, Fig. 1

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Leaves are pinnate, in most cases only fragments are visible. The leaflets of the pinnate leaf are long and narrow, their breadth rarely exceeding 2 cm. Their full length cannot be established from the fragmentary specimens. The leaflets arise from the lower side of the rachis, their cross-section being turned "V". Distally off the rachis, the lamina of the leaflet becomes level, and near the apex, the margin curves upward again. The most characteristic features of the leaflets are the rigid bristles. They are spaced at great distances from each other, sometimes even 1—2 cm; they are very thin, and in spite of their considerable length, well-preserved, which indicates very resistent tissue. The midvein is not marked, and the leaves bear very fine parallel vein networks.
Note: The species was described from Ipolytarnóc, by JABLONSZKY (1914). It can be found in large quantities, so apparently it is one of the dominating species. From the Lipovany flora NĚMEJC and KNOBLOCH (1973) mention only one leaflet of it. In this country it is known also from the section of the Wind brick factory at Eger, and from Magyaregregy.
Locality: Ipolytarnóc, Botos-árok I—V, Fehér-hegy, Csapás-völgy, Mogyoróskút.

Sabal ADAMSON

Sabal major (UNGER) HEER

Pl. XXXVI, Fig. 4, Pl. XXXVII, Figs. 2—3, Pl. XXXVIII, Figs. 1—3

List of synonyms, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: Several small fragments and some larger parts of the fanlike leaf have been preserved, in which the basal part and the short triangular rib is well visible. In this section the leaf is very "folded", then gradually "unfolds" and broadens. Thus, the laminas are narrower in their lower sections, while at the top they reach or exceed a breadth of 2 cm. The leaves are slightly asymmetrical.
Note: The species is known from the Upper Eocene to the Middle Miocene. It is mentioned by RÁSKY from the Ipolytarnóc flora as *S. major* and *S. haeringiana*. In our opinion, however, these impressions belong to the same species, and were treated separately by RÁSKY only because of the narrow veins nearer to the midrib and the fragment of the broader vein farther apart. 26 species of the Sabal genus live in the tropical coastal area of America. ANDREÁNSZKY (1959) is not sure that the European fossils really belong to the Sabal genus, just because of their spreading at the present day. In Ipolytarnóc, a relatively high number of Sabal leaves are present, which indicates that here this species lived near its ecological optimum. In addition to Europe, it was found also in the Middle Miocene of Daghestan.
Locality: Ipolytarnóc, Botos-árok I—III, V, Fehér-hegy, Csapás-völgy.

Araceophyllum tarnocense Rásky
Pl. XXXIX, Figs. 1, 2, 4

List of synonym, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See Rásky 1964, p. 69.
Locality: Ipolytarnóc, Botos-árok I, V.

Araceites hungaricus Rásky
Pl. XXXIX, Fig. 3

List of synonym, storage place and collection numbers of the material are to be seen in the Hungarian text.

Description: See Rásky 1964, p. 70.
Locality: Ipolytarnóc, Botos-árok IV.

FLORISTIC EVALUATION OF THE GYULAKESZI RHYOLITE TUFF FORMATION AT IPOLYTARNÓC

In the rich flora of the Gyulakeszi Rhyolite Tuff Formation at Ipolytarnóc, not only woody plants are to be found—although they are in dominating majority—but there are some, lower plants, too. Represented among them are **lichens,** which Rásky (1959) described under the name *Lobaria jablonszkyi.* The tuff has preserved relatively many lichen-colonies.

Several families of the **Filicales** have been found here, the majority spread all over Europe in the Miocene. *Pronephrium stiriacum* must have been wide-spread in Hungary, both in time and space. From the vicinity of Eger, it is known from the Upper Oligocene and the Middle Miocene, at Ipolytarnóc it was found in the Lower Miocene tuff. From data referring to the wide extension of *Woodwardia muensteriana*, it seems that it was rather limited to the Miocene. *Dryopteris kümmerlei*, which occurred in relatively small quantities, has been described from Ipolytarnóc. The numerical occurrence of *Asplenium sp.* falls behind that of the first two ferns.

Amongst the **Gymnospermae,** the absence of the Taxodiaceae family is remarkable. In Miocene floras the presence of Taxodium and Glyptostrobus is usual, these occurring in dominant quantities in some floras. In contrast to this, in the tuff of Ipolytarnóc only some fragments of *Libocedrites salicornioides*, belonging to the Cupressaceae family, *Pinus saturni*, *Pinuxylon tarnocziense* as well as *Pinus* sp. belonging to the Pinaceae family, have been found. It is interesting to trace the extension of *Libocedrites salicornioides* in Hungary and Europe. This species has been found in many localities of the Lower Oligocene Tard Clay Formation. Thus, in the Hungarian Lower Oligocene, it is—if not dominant—a characteristic species. From the Upper Oligocene only one single whorl was found at Vértesszőlős, and it is very poorly preserved (Hably, 1982). It is absent in the Wind brick-factory section as well as at Verőcemaros and in other Egerian localities. But it is a species, characteristic of the Egerian Stage in the Bohemian-Basin. In the tuff of Ipolytarnóc, i.e. in the Lower Miocene, it appears again in large quantities. With a number of specimens about a hundred, it is nearly a dominant species. The species is unknown in the later Miocene. Although Andreánszky published some Libocedrites remains from the Sarmatian at Felsőtárkány, its absence in the Hungarian Upper Oligocene remains unexplained.

The Pinaceae family is well represented in the Ipolytarnóc flora. Both the Eggenburgian sandstone and the Ottnangian tuff contain pine-needles. *P. saturni* is present in the Miocene flora of Switzerland. Presumably it was not a cold-temperate, but a thermophyl species. The Pinus genus in itself does not indicate a cold climate, as several species of it live within subtropical, mediterranean boundaries.

The total absence of the Taxodiaceae family is very remarkable. In the area of Hungary Sequoia and Taxodium lived also in the Lower Oligocene. In the Upper Oligocene Taxodium and Glyptostrobus are present already in dominating quantities in some localities (e.g. Vértesszőlős). These species are characteristic also of the later periods of the Miocene, and even in the Pliocene, in some places they are dominant. Their presence indicates marsh-vegetation. Glyptostrobus europaeus generally lived in the Late Sarmatian, together with *Byttneriophyllum tiliaefolium*, Nyssa and Myrica. From Ipolytarnóc such large quantity of fossil plant material was collected, as from very few other places, so, the possibility that the Taxodiaceae family failed to be included in the collection, can be excluded.

Of the **Angiospermae** plants, the Dicotyledons are represented in abundance. Among the Monocotyledons, palms play an important role, but the Smilax genus is also present. Of the Dicotyledons, it is undoubtedly the Lauraceae family, which is the richest in species, but it towers above the other plants also by its specimen number. In Ipolytarnóc the leaves of Daphnogene bilinica can be found in the largest quantities—over 1100 specimens—which makes it one of the dominant species of the flora (25 per cent) (Table 2). The Daphnogene genus is represented by several species, but their specimen numbers are much smaller. Laurus, Laurophyllum finds are present in considerable numbers, which although not dominant separately, are important for their quantities. At any rate, this is one of the most characteristic groups at Ipolytarnóc, its extreme diversity proves that it was living in its climatic optimum. The leathery, frequently drip-tip leaves testify to a warm, subtropical climate. After the Lauraceae family, it is the Juglandaceae family, which excels with its richness in specimens. This, however, does not show high diversity, one species of *Engelhardtia orsbergensis* and one of *Cyclocarya cyclocarpa* being present. Numerically it is Engelhardtia, which stands out with its specimen number of above 800 (17 per cent); this is significant even though we have to do with leaflets of compound leaves, C. cyclocarpa belongs also to the dominant and characteristic species with specimen number above 300 (7 per cent).

The Ipolytarnóc flora has yielded one more new and significant entry about the occurrence of *Platanus neptuni* in Hungary, younger than any other finds revealed so far. It had been found in several localities representing the Lower and the Upper Oligocene (Hably, 1979; 1980; 1982). Ipolytarnóc with over 400 specimens can be considered as one of the richest localities of this species even according to general by European standards. It is a dominant species in the flora. No other arctotertiary species of the genus is present but this single palaeotropical one.

The Fagaceae family is represented by one single dominant species, "*Quercus*" *cruciata;* the Quercus quality of this, however, is doubtful. With over 300 specimens, this is one of the characteristic plants of the flora. The family is represented also by an ancient type of species, *Dryophyllum furcinerve* with only three small leaves. *D. furcinerve* is a dominating species in Hungary in the Lower Oligocene, but in the Upper Oligocene it can be found only sporadically. Its appearance in the Miocene is unusual. The history and small specimen number of the species indicates that in Ipolytarnóc it lived as a relic in the Early Miocene.

The dominating families and species are well distinguishable. The above are the only dicotyledonous plants, which can be classified here. The rest of the species, represented by about ten specimens, can be considered negligible, as compared to species represented by hundreds of specimens. These are the accessory elements of the flora, which may have come to Ipolytarnóc from the flora of the neighbourhood, and there are some among them, which became preponderant later, e.g. Podogonium.

The dominant species are mainly palaeotropical. The members of the Lauraceae family, *Platanus neptuni* are palaeotropical by all means. There are few, strictly arctotertiary elements. A typically arctotertiary species is *Acer tricuspidatum*, which, however, exists in very small quantities. Engelhardtia and Cyclocarya are not arctotertiary genera, and are by no means cryophytic plants.

Palms, as it has been mentioned, had a very important role to play at Ipolytarnóc. *Calamus noszkyi* with a specimen of about 800 (18 per cent), is the second dominant species in the tuff. Even, if as known, the leaves are apparently fragments. More than 130 specimens (3 per cent) of the leaves of *Sabal major* palm have been found.

With the exception of palms and Smilax, no other monocotyledonous impression has been found. Three species of *Smilax; weberi*, *aspera* and *borsodensis* are present in Ipolytarnóc. This genus is generally widespread in the Miocene. The majority of the members of this genus are creepers of tropical-subtropical forests. Their presence at Ipolytarnóc indicate that the forest had a liane-level, similarly to the tropical-subtropical forests of the present day.

A floristic evaluation of the Ipolytarnóc remains shows that the palaeotropical elements are in preponderance. The number of typically arctotertiary elements in the tuff is very small. The flora of the sandstone under the tuff contains an additional arctotertiary species, *Ulmus pyramidalis*. The tuff-emission having been a quick process, Ulmus cannot be supposed to have migrated in the meantime. This would contradict also the fact, that in the Tertiary, the arctotertiary elements were growing more and more dominant. In our view the solution lies in palaeogeographical causes. This will be discussed later.

Examining of the living relatives of these species, we see that the majority have South-Asiatic connections. There are no East-Mediterranean related species (Zelkova, Parrotia, Quercus kubinyii) in the flora. These mostly appeared in the Karpatian and the Sarmatian, and were dominant elements of the flora in some places. *The Ipolytarnóc flora with various lauriform species does not present, yet, a floristic composition characteristic of the Neogene.*

PLANT-ASSEMBLAGES OF THE FLORA

Reconstructing plant-assemblages on the basis of the principle of uniformity, it can be supposed, that extinct plants had lived in assemblages, similar to those of today. Considering the living-site in the first place: species characteristic of swamps, riversides, hilly and mountainous regions can be found here.

The rich flora of the Ipolytarnóc tuff makes it possible to see real areal separations. In opposition with the floras of clayey and sandy deposits, the assemblage here is not accumulated by water, but it is a flora which was buried more or less on the spot by the tuff. Collections having been made in different areas, we shall attempt to define those assemblages, which serve as a basis for constructing the palaeogeographical image. Naturally, only those remains can be used in the evaluation, whose locality is exactly known. We have finds from six places in Botos-árok, from Fehér-hegy, Borókás-árok, Csapás-völgy and Mogyoróskút. The evaluation is primarily based on the dominating species which were present in assemblage-forming quantities.

Daphnogene bilinica is present in the largest quantities in **Botos-árok V** locality (473 pieces). This is one of the places, richest in plant-fossils. With a dominating quantity of *Engelhardtia orsbergensis* (510 pieces), *Cyclocarya cyclocarpa* (210 pieces), *Calamus noszkyi* (234 pieces), *Pinus saturni* (69 pieces) as well as *Araceophyllum tarnocense* (71 pieces). The two last species were found only here and nowhere else. With fewer specimens several other species are present here. The dominating species of trees, may have been Engelhardtia orsbergensis and Cyclocarya cyclocarpa whereas Daphnogene bilinica formed a dense shrub-level or a lower foliage-level. Mixed with these, there was a high number of palms, primarily Calamus noszkyi and Araceophyllum tarnocense. The shrub-level was enriched by several Daphnogene species. Pinus saturni, found in the tuff, exclusively in this place, indicates the presence of a mixed forest.

A preponderant majority of Engelhardtia orsbergensis and Cyclocarya cyclocarpa constituted the forest, which had existed in the locality of Botos-árok V. It is to be seen in Table 2 that although they spread from here over the neighbourhood, it was here that they had a primary role of assemblage-formation.

A further testing of the localities confirms our supposition, that in this area of 1.5 sq.km, definite assemblages were separated. **Botos-árok IV** locality contained 77 per cent of *Platanus neptuni* specimens. No other species is present in dominating quantities. The forest consisted exclusively of Platanus neptuni with only a few Engelhardtia, Cyclocarya and "Quercus" cruciata, mixing with this species. In the forest a shrub-level, probably different from Platanus, was formed by Daphnogene bilinica, Litsea ipolytarnocense and Laurus princeps. The majority of the representatives of the last two species belong here. Palms are represented only by Calamus, and in small quantities.

The **Botos-árok I** locality does not create the impression of pure assemblage. Here *Daphnogene bilinica* is a dominating species (212 pieces, 42 per cent). Some species are represented in nearly the same quantities, e.g. *Engelhardtia orsbergensis* (14 per cent), *Calamus noszkyi* (10 per cent), *Libocedrites salicornioides* (13 per cent). Of Cyclocarya cyclocarpa, Pinus sp., "Quercus" cruciata and Platanus neptuni merely one or two specimens can be registered. The character of the locality is governed by *Libocedrites salicornioides* (with 76 per cent of this species having lived here). It is characteristic of this place that several species are present by one or two specimens.

Considering the area of the above site Botos-árok I, it seems to have formed a bordering zone to of assemblages with several specimens. Libocedrites salicornioides was a plant of broad-leafed evergreen forests. Here Acer tricuspidatum is present, a plant, excluded from closed tightly-formed assemblages.

Botos-árok II locality offers one of the most unusual assemblage-types. The dominating species being markedly separated, it is to be presumed, that this was a real assemblage, all the more that the largest quantity by 64 per cent of the remains of "*Quercus*" *cruciata* can be found here. We find the first maximum by 47 per cent of the *Calamus noszkyi* with two maximums, in Botos-árok II and its second maximum (28 per cent) in Botos-árok V. Here the third dominating species is *Daphnogene bilinica* (13 per cent, constituting at the same time 10 per cent of the total of the specimens). With the above three species then, the assemblage can be *characterized as "Quercus" cruciata—Calamus noszkyi—Daphnogene bilinica assemblage*, in whose herb-level Woodwardia muensteriana was thriving. Occasionally, there were Engelhardtia, Cyclocarya, Platanus neptuni as well as some other Daphnogene species mixing with the assemblage.

A relatively large quantity of plant-remains was found also in **Fehér-hegy**, with *Daphnogene bilinica* being the dominating species also here. Added to it, *Calamus noszkyi* and *Engelhardtia orsbergensis* are present in considerable quantities with fewer "Quercus" cruciata, Daphnogene polymorpha, Platanus neptuni and Sabal major. Considering its composition, Botos-árok II stands closest to Calamus noszkyi—"Quercus" cruciata—Daphnogene bilinica assemblage.

The rest of the localities, shown in Table 2 cannot be evaluated in this way, either because the information about the locality is not sufficiently exact, e.g. Botos-árok, Csapás-völgy, or because too few remains have been found (e.g. Botos-árok III, VI).

Borókás-árok locality yielded almost exclusively *Engelhardtia orsbergensis* and *Cyclocarya cyclocarpa:* a further evidence of these two species having formed assemblage with each other.

In **Csapás-völgy** *Sabal major* is present in outstanding quantities (taking up 46 per cent of all the specimens), but no far-reaching consequences can be drawn from this fact, since the locality is poor in other species as well.

In the small collection from **Mogyoróskút,** *Engelhardtia orsbegensis*, *Daphnogene bilinica*, *Calamus noszkyi* and "*Quercus*" *cruciata* can be found.

Summing up, the following assemblages are stated on the basis of the dominating species:

1. *Platanus neptuni* (Botos-árok IV).
2. *Engelhardtia orsbergensis—Cyclocarya cyclocarpa—Calamus noszkyi—Daphnogene bilinica* (Botos-árok V, Borókás-árok?).
3. *"Quercus" cruciata—Calamus noszkyi—Daphnogene bilinica* (Botos-árok II, Fehér-hegy).

As it is shown by Table 2 *Daphnogene bilinica* is present in almost all localities, mostly in dominating quantities, and therefore, it is not a suitable indicator of differences. It can be stated that this was the dominating species everywhere in this area, at the lower foliage-level and at the shrub-level. An exception from this, is the *Platanus neptuni* forest, in which *Litsea ipolytarnocense* is most widespread.

Platanus neptuni is concentrated in Botos-árok IV locality, radiating to the surrounding area only in smaller quantities; it is a species, typically with one maximum. Also *Cyclocarya cyclocarpa* shows one maximum, but its radius of extension may have been larger, as testified by the impressions found.

Like Cyclocarya, *Engelhardtia orsbergensis* is present in Botos-árok V in high concentration, but it can be found in almost all the localities, in high number of specimens. It was a dominant, thriving species in Ipolytarnóc.

Calamus noszkyi shows markedly two maximums, one in Botos-árok II, and the other the locality of Botos-árok V. This widespread species was present not only in Botos-árok I, but also at Fehérhegy and Mogyoróskút.

"Quercus" cruciata appears in Botos-árok II locality with one maximum. Its radius of spread was probably smaller than that of Daphnogene bilinica and Engelhardtia orsbergensis, but it did not fall too much behind.

Besides the dominating species, it is worth having a look at **the accessory elements of the flora.** Some are so numerous that can almost be considered dominant like *Libocedrites salicornioides*, which is a species definitely with a maximum in Botos-árok I. This was not present in closed forest assemblage, but probably favoured thinned forests and groves. It is present in several localities, but only in insignificant quantities. *Pinus saturni* is confined to Botos-árok V, i.e. it occurs in the second assemblage. Pinus sp. fragments, however, come from other places as well. *Araceophyllum tarnocense* is also bound up with the above assemblage. Presumably this forest offered the most enclosed surroundings, and thus, the highest humidity. *Litsea ipolytarnocense* is also a member of the 2nd assemblage. A great majority of the species are associated with this assemblage, such as Myrtophyllum sp., Spiraea sp. 1, Spiraea sp. 2, Daphne oehningense. *Pronephrium stiriacum* was found in largest quantities also here, which too, proves humid conditions. Ferns like this, usually live in the marsh-vegetation of a warmer climatic belt. All the three palms are present in this type of assemblage.

It is striking, that in opposition with the Daphnogene species, *Laurus princeps* is attached not to the second assemblage, but to the first one, i.e. to Platanus neptuni. Laurophyllum, Laurus, Persea species, which are present in great diversity but in relatively small specimen number, were found primarily in Botos-árok I locality. Probably illumination was more favourable for them here.

As seen above, most species have maximum occurrence with the exception of a few indifferent ones. This supports unequivocally our supposition that the assemblages were separated. According to ANDREÁNSZKY (1955) the assemblages were formed during the Miocene, and kept re-assembling continuously. In our view the plant assemblages had been formed earlier on. Already in the *Oligocene* there can be traced assemblages which, of course, had undergone changes with the alterations in the flora. For example, Platanus neptuni forms assemblages in the Hungarian *Lower Oligocene* with Dryophyllum furcinerve, Zizyphus zizyphoides and Daphnogene species. In the *Upper Oligocene* Dryophyllum furcinerve and Zizyphus zizyphoides are practically missing. Here Platanus neptuni forms assemblages with the Daphnogene species, mixed with other lauriforms and Quercus species, but neither of them is dominating or even on equal status with Platanus neptuni. The latter species continues to have an independent role in the *Lower Miocene* with lauriform plants: Daphnogene and Litsea only in its shrub-level.

Engelhardtia orsbergensis played no assemblage-forming role before the Miocene. In the Lower Oligocene it is represented only in small numbers, and it does not become significant even in the Upper Oligocene. It shows a burst only in Ipolytarnóc, as does Cyclocarya cyclocarpa. This at the same time means a considerable stage of development of the Juglandaceae family and the appearance of the Carya relatives.

FLORA OF THE FOOTPRINT SANDSTONE OF THE ZAGYVAPÁLFALVA MOTTLED CLAY FORMATION

The tuff, which is rich in leaf-impressions rests on a sandstone bed. This is the so-called footprint sandstone, which, in some places, contains also plant remains, but their preservation is considerably poorer than that of the ones in the tuff. The sandstone having coarser grain size, cannot adopt the impression of finer leaf-details in the process of fossilization. In many cases, the leaf margin was totally damaged, and thus, the teeth cannot be seen at all. The venation is more poorly visible, too. In many cases, even the secondary venation cannot be fully seen, while in the tuff the tertiary and quaternary venations are visible. In the sandstone the leaves very often cover each other. The very numerous plant-remains on the bedding surface are mainly fragments. Even the relatively well-preserved impressions cannot be defined with full certainty. Since their margin is, in most cases, fragmentary, owing to the poor preservation, considerably fewer remains have been collected and determined from here, than from the tuff. Most of the determinations are uncertain. In the beginning Staub dealt with it, but he did not publish his material. Jablonszky (1914, p. 229) mentions the following species from the flora of the footprint sandstone:

Glyptostrobus europaeus Heer, *Podocarpus eocenica* Ung., *Pinus* leaves and cone-fragments, which may be identical with Pinus tarnócensis, *Cyperites canaliculatus* Heer, *Palmacites (Sabal?)*, *Populus heliadum* Ung., *Juglans acuminata* A. Br., *Myrica salinica* Ung., *Carpinus grandis* Ung. (dominant), *Cinnamomum Scheuchzeri*, *Laurus lalages* Ung., *Papilionaceae* fruit, *Andromeda protogeae* Ung., *Tabernaemontana?*, *Phyllites* sp., *Rhizocaulon macrophyllum* Sap.

Jablonszky notes: "The value of these determinations is rather doubtful, because practically nothing of the venation of the leaf is visible" (p. 230). Further, he deals not with these, but with the flora of the tuff providing more information.

Rásky did not deal specially with the flora of the sandstone either, but she described a new species (1964, p. 72), under the name *Leguminocarpon pachyrhisoides*, which is mentioned by Jablonszky as Papilionaceae fruit. Also *Araceites hungaricus* (1964, p. 70) is its new species. This, however, was found also in the tuff.

The flora of the sandstone was re-determined by Pálfalvy (1976). His list of species differs from the previous ones, as far as new names are concerned:

Glyptostrobus europaeus (Brongn.) Ung., *Pinus* sp. (two-needled), *Pinus* sp. (three-needled), *Pinus* sp. (five-needled, frequent), *Pinus* sp. (con., frequent), *Magnolia* cf. *dianae* Ung., *Laurophyllum* sp. (cf. *Laurus lalages* Ung.), *Laurophyllum* sp., *Daphnogene bilinica* (Ung.) Kvaček et Knobl., *D. cinnamomea* (Rossm.) Knobl., *Leguminocarpon pachyrhisoides* Rásky, *Leucothoe protogaea* (Ung.) Sap., cf. *Ulmus pyramidalis* Goepp., *Ulmus* sp., *Carpinus grandis* Ung. (dominant), *Juglans acuminata* A. Br., *Populus* cf. *populina* (Brongn.) Knobl., *Salix* cf. *augusta* A. Br., *Myrica banksiaefolia* Ung. (frequent), *M. lignitum* (Ung.) Sap., *M. salicina* Ung., *M. serotina* (Heer) Hantke, *Cyperites canaliculatus* Heer, *Phragmites oehningensis* A. Br., *Palmacites* sp. *(?Sabal)*, *Araceites hungaricus* Rásky, Graminae et Cyperaceae indet.

Pine-needles are very frequent in the sandstone, they are easy to recognize, and owing to their substance and form, they are less damaged than the large dicotyledonous leaves. The tuff, however, yielded pine-needles only at some places. This could create the deceptive appearance, that conifers are characteristic of the sandstone, and lauriforms of the tuff.

Re-checking the flora of the sandstone we found that only in the appearance of one species, the *Ulmus pyramidalis*, can we find considerable difference. *This species is present only in the sandstone, and cannot be found in the tuff at all.* Pinus, however, is found not only in the sandstone, but also in the tuff, in large quantities. *Daphnogene bilinica* is present in large quantities both in the sandstone and in the tuff. A new entry is the *Platanus neptuni* leaf found in the sandstone; in earlier lists of species it appears under the name Juglans acuminata, Salix, Myrica and other names (Jablonszky 1914, Pálfalvy 1974), or remains undetermined. Most of these remains are fragmentary, but in several specimens the asymmetrical base and the venation pattern are well visible, and in some impressions even the teeth have been preserved, which leaves no doubt about the plant. *Engelhardtia orsbergensis* is very poorly preserved; in earlier lists of species it was called Podocarpus eocenica (Jablonszky, 1914), as well as Myrica lignitum (Rásky, 1959), M. banksiaefolia, or listed under other names (Pálfalvy, 1974). In spite of the undoubtedly poor preservation of the leaves, knowing several preservation forms and details of the remains found in the tuff, we are convinced, that these are Engelhardtia orsbergensis impressions.

In addition to these, there are lauriform species belonging to the Lauraceae family, but about these, it is impossible to tell more, because of their preservation. In the list of species made by Jablonszky and Pálfalvy, these figure under the names: Magnolia, Laurus, Laurophyllum. In the course of revision, however, we could not find (or listed into other morphological group) the remains of some leaves contained in previous lists of species, such as Glyptostrobus europaeus, Populus and Salix species.

Before summarizing our view of the flora of the sandstone, we make mention of the remains which we call *Ulmus pyramidalis* Goepp., which are found only in the sandstone. These are mentioned by Jablonszky and Pálfalvy under the name *Carpinus grandis*, as a dominating species. Pálfalvy, however, includes also *Ulmus* sp. and cf. *Ulmus pyramidalis* in the list. Considering the teeth of the relatively entire impressions, as well as the asymmetrical bases, visible in some cases, *in our opinion the remains mentioned, is Ulmus pyramidalis*. The two species are really difficult to distinguish from each other, in case of fragmentary specimens; the possibility of the presence of both species in the flora cannot be excluded and also a Carpinus fruit is found here.

Comparing the floras of the footprint sandstone and the tuff, it can be stated, that they show no essential differences in their composition of species, i.e. the two floras are identical. Rásky stresses: "The upper level of the glauconitic 'sandstone with footprints' and the rhyolitic tuff with the plantremains embedded in it, form a biostratonomic unit and it is impossible to draw a geologic boundary line between them. The plants embedded in the rhyolitic tuff show that they belong to the vegetation which lived before the volcanic outburst" (1959, pp. 453–454).

The quantitative comparison of the floras of the tuff and the sandstone could lead to false consequences, because there are differences in scale between the specimen numbers. The sandstone which is poorer in plant remains, contains only one species, absent in the tuff, the rest are common.

The flora of the sandstone is accumulated by water as indicated by fragments and the presence of leaves covering one another and piled upon each other. The reason for the smaller species number is, that during transportation the leaves ranished or became unrecognizable. So, there are determinable specimens left only of the dominating species, as well as of ones, living near the place of fossilization. That is why there are a lot of Daphnogene bilinica, Platanus neptuni, Engelhardtia orsbergensis, Laurophyllum leaf remains, having been dominating species here. The preservation of the large number of the pine needles can be explained by their hardness and power of resistence. The large quantity of Ulmus pyramidalis is due to the fact that its former growing on riverbanks and in marsh flood-plain i.e. close to the place of fossilization. As an arctotertiary element, Ulmus pyramidalis slightly alters the face of the flora of the sandstone. But this is not to be examined by climatic differences, but by edaphic factors. Ulmus lives typically in flood-plains and near rivers. Along gullies, it deeply penetrates other climatic zones as well, bringing about edaphic and intrazonal assemblages. This phenomenon can be seen in our days. Along the rivers, species like Alnus, Ulmus, Salix etc. can well penetrate into the interior of tropics. This was a likely way how it had got into the Ipolytarnóc flora.

VEGETATION OF IPOLYTARNÓC AND PALAEOGEOGRAPHICAL INTERPRETATION

On the basis of the mass presence of Myrica, Jablonszky (1914) imagined this area as a seaside swamp. According to him "That vegetation would have been similar to the one, living today in the coastal regions of East-Asia or in the swamps along the shores of the Gulf of Mexico, in which the plants were conditioned by the humidity of the soil" (p. 273). *The specimens determined as M. lignitum, however, turned out to belong mainly to the Engelhardtia orsbergensis species, and occasionally to other species. Myrica lignitum is totally absent*, the taxonomic status of "Myrica" hakeaefolia is uncertain, but there are only a few impressions of this in the flora. *Taxodium and Glyptostrobus, usually characteristic of the Miocene marshes*, and other marshland plants e.g. Byttneriophyllum tiliaefolium, are *not present*.

So, on revision of the megaflora, the existence of a swamps environment can be excluded. In our opinion, the area was crossed by some river, as it was supposed by Tuzson (1901, p. 278). *The broad bed and the flood-plain of this river was the living-space of the vegetation.* This view is supported by the remains of Ulmus pyramidalis (vel Carpinus grandis?) frequent in the sandstone. As mentioned before, Ulmus is not present in the tuff, while it is contained by the sandstone in large quantities. The tuff-outburst was so quick, that there was no time left for the transformation of the vegetation. *The plant-community settled and living on the sandstone, was fixed by the tuff through a sudden burying. The plants lived not on the tuff bottom.* The Ulmus species, as today, would have formed riverside flood-plain forests on the banks, this is why the leaf impressions can be found in the fossil flora of the sandstone. The leaves were carried by the water and therefore they were preserved near the river and its bed, and on flood-plains. They did not exist farther away from the river, thus their remains are absent from the tuff.

Farther off the streams, on outstanding hammocks lived the vegetation, referred to as the flora of the tuff. The fallen leaves of the plants had fossilized in the usual way within the sandy sediment, already before the tuff-emission. This is proved by the presence of Daphnogene bilinica, Platanus neptuni, Engelhardtia orsbergensis and Laurophyllum species, in the flora of the sandstone. Having reached the spot of fossilization after transportation, they broke into pieces, and only a few entire specimens have remained. Contrary to this, Ulmus lived "on the spot", thus its chances of fossilization were better.

In our opinion, the vegetations of the sandstone and the tuff demonstrate no climatic differences at all, and this is natural as there are no essential differences in their floristic elements.

As shown before, farther off the riverbanks, there were three separate assemblages in this area. The species of the assemblages naturally penetrated other assemblages. Botos-ditch I locality may have been the boundary of the assemblages and the place where they came into contact. The array of Platanus neptuni is typically an assemblage living far from the banks. It must have lived in outstanding hammocks for example on hilltops (Fig. 27). Neither Engelhardtia orsbergensis—Cyclocarya cyclocarpa—Calamus noszkyi—Daphnogene bilinica-assemblage is of waterside. Same is though about the "Quercus" cruciata—Daphnogene bilinica—Calamus noszkyi-assemblage. All these communities lived in dry sites, not very far away from the river. The more or less abundant material of different localities provides little information as to, whether the place was covered by forests. The poor material of Botos-árok III locality suggests that the original vegetation here was also sparser.

COMPARISON OF THE IPOLYTARNÓC FLORA WITH OTHER FLORAS OF SIMILAR AGE

In 1966 Němejc and Knobloch discovered some plant impressions in the tuff near the village of Lipovany (Romhánypuszta) situated in Slovakia, 6 kilometres away from Ipolytarnóc. As a sum total, thirty impressions have been collected, and later collections were made impossible by the smashing up of the locality. They published their material in 1973. Their species are as follows:

Myrica cf. *sagoriana*, aff. *Quercus neriifolia*, *Cyclocarya cyclocarpa*, *Engelhardtia macroptera*, *E. detecta*, *Engelhardtia* sp., *Daphnogene bilinica*, *D. cinnamomeifolia*, *D. spectabile*, *Laurophyllum* cf. *braunii*, *L.* cf. *reussii*, *L.* cf. *lalages*, *L.* cf. *heeri*, *L.* cf. *princeps*, *L.* sp., cf. "*Laurus*" cf. *primigenia*, *Diospyros brachysepala*, ?"*Notelaea*" sp., *Ceanothus* sp. vel *Zizyphus* sp., *Acer angustilobum*, *Sapindus falcifolius*, cf. *Nyssa* sp., "*Robinia*" *regeli*, aff. *Andromeda* sp., *Calamus noszkyi*.

Comparing the floras of Ipolytarnóc and Lipovany it becomes clear that Ipolytarnóc contains all the species found at Lipovany. As attested to by the number of fossils fewer by orders at Lipovany than at Ipolytarnóc, the flora of the latter zone likewise must have been poorer. Otherwise the two areas are closely situated very and both floras were fossilized in the same formation, namely the Gyulakeszi Rhyolite Tuff Formation. The flora of Lipovany can actually be interpreted as part of the Ipolytarnóc flora. In both places the flora was embedded simultaneously by the tuff-outburst. So, naturally we have to do with identical plant species in both places.

Also Knobloch (Němejc et Knobloch, 1973) compares the Lipovany flora with Ipolytarnóc; on account of its considerably larger specimen and species number, the latter being easier to evaluate. As it was not possible to determine dominating species from the small specimen number of the Lipovany flora, Knobloch (Knobloch et al. 1975) visited the Ipolytarnóc locality and collected additional remains there. Then, based on these and relevant data in literature, he set the Engelhardtia detecta—Laurophyllum div. sp.—Calamus noszkyi flora-zone for the Ottnangian Stage. This flora-zone, however, has to be modified, because among the dominating species Platanus neptuni has an outstanding role to play. This cannot be missed in the name of the zone and so, a *Platanus neptuni—Engelhardtia orsbergensis—Laurophyllum div. sp.—Calamus noszkyi flora-zone will be determined with Ipolytarnóc, its holotype area, and Lipovany, its paratype area.*

The shifting of the holotype area can be justified by:

a) The Ipolytarnóc locality has been known for nearly 150 years, since 1837.
b) Since Ipolytarnóc was discovered, nearly 10,000 impressions have been collected, whereas from Lipovany only thirty. In the present revision only 41 genera and 65 species of the leaf-remains are shown. Thus, both in specimen number and species number (15 genera, 24 species) Lipovany is far behind the Ipolytarnóc locality.
c) The Lipovany locality does not exist anymore, while Ipolytarnóc has been declared a strictly protected area, thus, not only the collections, but the locality itself are at the disposal of researchers.

The comparison made between the flora of Ipolytarnóc and other Miocene floras indicates that also the climate of Germany and the Moravian-Basin warmed up to a considerable extent. In Germany the Mastixioidea flora, the Flora-zone II of Mai (1967) is, at this time, a flora definitely thermophyl, subtropical. The flora of Znojmo in the Moravian Basin (Knobloch, 1969) also shows warming up in this time. Contrary to the flora of Ipolytarnóc, the Znojmo one was xerophyl. Their mutual feature is that arctotertiary elements are missing from them. The peculiar, small-leafed flora of Znojmo is a subtropical, xerophyl one, but not extremely xerophyl. From the Lower Miocene of the Bohemian Basin, also Mastixioidea flora was reported with Mastixia, Castanopsis, Magnolia and Tetrastigma genera.

In Europe the warming up at the beginning of the Miocene is the initial wave of the oscillatory climate, present during the Miocene. The various events occurring in the Miocene, probably had a great influence on the vegetation as well. Thus, the flora and vegetation composition of Europe changed frequently during the Miocene.

CLIMATE

The flora provides accurate information about the Early Miocene climate of Ipolytarnóc, partly because the tuff preserved the leaf-impressions very well, and thus, the morphological characteristics can be well interpreted; partly because with the help of the great number of remains, it can be also statistically assessed which are the species primarily essential and decisive in reconstructing the climate.

The morphological characteristics themselves, are very revealing. *The large size of the Laurus leaves, unequivocally testify to wet climate* (Table 3). This is supported and proved by those remains, which have drip-tips (Laurus princeps). Drip-tips develop only in tropical-subtropical wet conditions with very high humidity. Also Platanus neptuni has large leaves. Small leaves, as seen before, are not connected with climatic reasons, buth with their arrangement on the shoot. Also the species of the Lauraceae family appear with large, often with very large leaves.

The proofs of the humid-wet climate are, of course, not only morphological. *Ferns are likely to be present mainly under humid conditions.* In Ipolytarnóc there lived several species of ferns, and they must have spread on a large area as they occur in large numbers, even in fossil materials. *Palms are the most significant proofs of warm climate:* Calamus noszkyi and Sabal major. The northern border of the natural existence of palms is the subtropical area. They cannot tolerate long-lasting frost. In Ipolytarnóc there is such an abundance of palms, that they cannot be regarded receeding elements. They are present in dominating quantity, therefore we are justified in stating that they were living at their ecological optimum.

The dominating species are all thermophyl. There are hardly any species, requiring temperate climate. Acer tricuspidatum is thermophyl to a certain extent, as it lived predominantly in the Miocene, and became extinct later, when the colder climate set in. Smilax is a subtropical creeper, also living in warm climate. At a colder climate, than the subtropical, there is no liane-level in the forest. Relatively little is known about the ecology of "Quercus" cruciata, as its taxonomic status is not clarified. Though highly dissected, its large leaves do not indicate xerophylia. It is present in the Egerian beds now studiable in the Wind brick factory opencast at Eger, representing a testimony to warm subtropical conditions.

The composition of the flora indicates warm subtropical rainforest-type of vegetation. In accordance with Rásky's opinion (1959, p. 455), it can be stated *that temperature did not reach freezing point, the annual average temperature was about 20 °C.*

There is no possibility to make comparisons with other Lower Miocene floras in Hungary, Ipolytarnóc being the only excavated flora of this age. Comparing it with the Miocene floras of adjacent areas, we find that in time the Ipolytarnóc flora coincides with the Zone II set up by Mai (1967). The German floras, belonging to this zone, are characterized by lauriform elements, Symplocos, Mastixia, i.e. the Mastixioidea flora was dominant. As it is known, this flora has its optimum under the tropical conditions of the Eocene, and then it re-appeared in the warming up period of the Miocene. The presence of the Mastixioidea flora proves a climate with at least subtropical temperature in the area of Germany. On the basis of the Lipovany and Ipolytarnóc localities, the Ottnangian in Czechoslovakia is characterized by Knobloch (Knobloch et al. 1975) by the Engelhardtia—Laurophyllum div. sp.—Calamus noszkyi zone, some authors compare the lauriform, entire-margined leaves, i.e. the thermophyl elements of the Lipovany flora, to the flora of China and South-Japan. In Germany the appearance of the Mastixioidea flora indicates considerable rise in temperature. In Hungary Mastixia has not been found so far, but the flora indicates a rise in temperature.

Summing up, it can be stated, that at the beginning of the Ottnangian, a warm- subtropical climate prevailed in Ipolytarnóc. In this semihumid warm climate assemblages of rich, multi-levelled lauriform forests came into being. These were zonal assemblages, whose formation was primarily determined by their zonal position, i.e. the climate. Arctotertiary elements were supressed. Ulmus pyramidalis which is present in relatively large quantities—but very small, as compared to the dominating species!—owes its presence not to climatic, bit to edaphic factors. In a climate favouring thermophyl species, arctotertiary elements were unable to prevail, and they could penetrate only those living spaces which were not used by the thermophyl species to full extent.

The Ecological Characters of Some Species

Table 3

Dryopteris kümmerlei	Possibly living at herb-level of forests in humid wet shady places.
Asplenium sp.	Living at herb-level of forests in humid, wet, shady places, together with Woodwardia muensteriana and Pronephrium stiriacum.
Magnolia kristianae *Magnolia mirabilis*	Probably thermophyl, cryophytic, deciduous tropical species.
Persea braunii	Large lauriform leaves indicating woody plants and shrubs of subtropical rainforests.
„Persea" speciosa	Large lauriform leaves indicating wet climate.
Daphnogene cinnamomifolia	Lived in lauriform forests of subtropical—tropical climatic zone.
Daphnogene cinnamomeifolia	Living in low foliage-level of lauriform forests and at shrub-level.
Daphnogene bilinica *Daphnogene spectabile*	Thermophyl elements, lauriform trees or shrubs of subtropical rainforests.
Litsea ipolytarnocense	Occurs together with Daphnogene species supposed to be similar to those favouring warm, wet subtropical climate.
Laurus princeps	Long drip-tip morphological proof of warm humid climate.
Laurophyllum pseudoprinceps	Thrived at shrub-level in assemblage with Laurus princeps and Daphnogene bilinica, i.e. under similar conditions of these.
Platanus neptuni	Palaeotropical thermophyl species. Lived in hilly areas, at some distance from the waterside, forming forest-vegetation mainly with lauriform-leafed species.
„Quercus" cruciata	Found in arctotertiary floras together with lauriform species. Localities in Hungary: Tállya, Eger, Parassapuszta. In our opinion the leathery leaf here does not indicate arctotertiary flora, but the mother plant was member of older thermophyl flora.
Engelhardtia orsbergensis	Ecologically very significant species, appears mainly attached to Mastixioidea floras. According to Kvaček (1972), a definitely subtropical element of European Tertiary floras. Although morphological structure of leaf seemingly indicates xeromorphia, this is refuted by slightly cutinous epidermis and undulate cell wall. Referring to Lower Oligocene finds, Andreánszky considered it xerophytic (1966). This confirmed by the examination of leaves from Kiscell 1 borehole; here, however, very cutinous epidermis and straight cell wall were found. According to Jähnichen (1977) the species lived within a long ecological interval. In our opinion, however, it had never been a dominating species under dry climatic conditions. Its ecological optimum is by all means the subtropical area. In Ipolytarnóc the mother-plant lived under optimal conditions alongside with thermophyl plants such as palms and Platanus neptuni. The present Engelhardtia species have lived in subtropical—tropical evergreen rainforests, mainly in the mountainous areas of South-East-Asia, Malaysia and the East-Himalayan mountain-regions.
Cyclocarya cyclocarpa	Probably thermophyl, hygrophytic plant of subtropical rainforests.
Elaeocarpus palaeolanceolatus	According to Kolakovskiy, present equivalent of E. lanceolatus Bulme living on the island of Java. Fossil specimen probably evergreen wood plant, member of montane forests at wet, subtropical climate.
Podogonium oehningense	It appeared in the Hungarian flora at the beginning of the Miocene, gradually gaining ground later, several factors helped its spreading on a wider area, in the Sarmatian at Tállya, then with the decrease in temperature it receeded and became extinct at the end of the Miocene.
Daphne oehningensis	Nearly 100 species of the Daphne genus is known from Europe and Asia. Most of them are small leaves of nearly identical form; it is hard to differentiate between them. Judging by the habitus of the Ipolytarnóc leaves and the comparative species living today, it was an evergreen leathery leafed shrub.

Acer tricuspidatum	Its occurrence can be assessed as the appearance of the arctotertiary flora. In our flora, predominantly lauriform and of subtropical character, the arctotertiary species had no great role to play. Also Acer tricuspidatum occurred only sporadically. The climatological conditions were still favourable also for palaeotropical thermophyl elements, thus, the invasion of the arctotertiary species is not noticable in the Ottnangian Stage.
Oreopanax protomulticaulis	Its genus is widespread mainly in East-Asia.
aff. *Andromeda* sp.	The members of the Ericaceae family live mainly in subalpine regions and high mountains, so they are by no means members of subtropical rainforest. At higher altitudes above sea-level the species may occur even in warmer climatic belts, therefore the possibility of its presence in Ipolytarnóc cannot be excluded.
Smilax weberi *Smilax aspera* (fossil)	The ecological demand of the Smilax genus can be more or less outlined on the basis of geographical extension. It does not exist in areas where the climate is colder than the mediterranean one. It is a creeper living in the liana-level of forests near seacoasts, under mediterranean subtropical and tropical climate.
Calamus noszkyi	250 species of the Calamus genus live in the rainforests of Indonesia and tropical Africa. The genus then, is definitely tropical, thermophyl, so this species as well as a great number of others, supports the theory that the Ipolytarnóc flora demanded high temperature and wet climate. The relatively small pointlike area of the species indicates endemic characteristics. Its absence in later periods suggests that its radiation was prevented by the change of climate.
Sabal major	The species being a palm, indicates warm wet climate. The majority of the species belonging to this genus and living today, are maritime, but some can be found in coniferous forests. 26 species live in the tropical coastal area of America.

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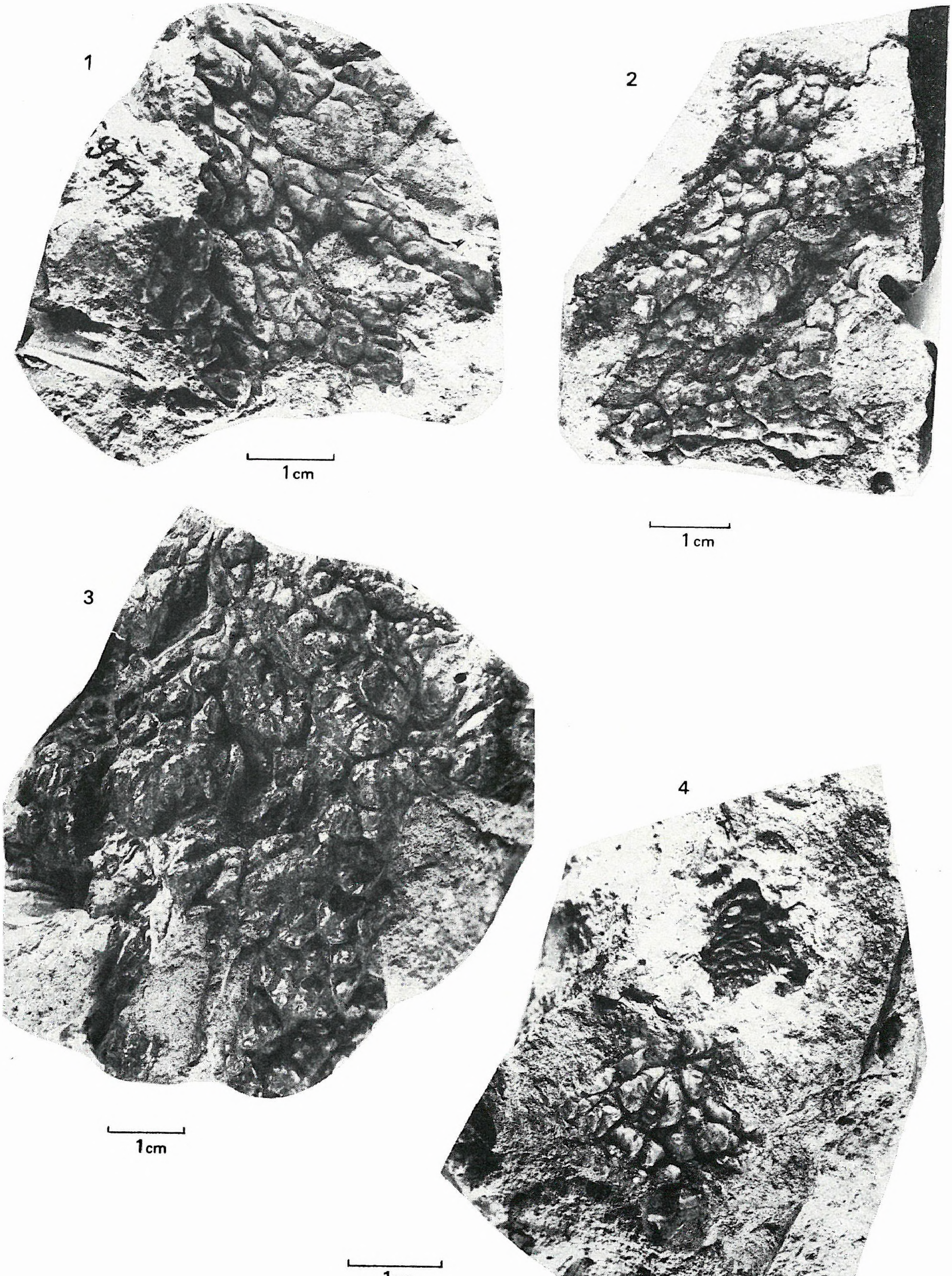
TÁBLÁK — PLATES

Photo: Mrs. Dr. Pellérdy

1. *Lobaria jablonszkyi* RÁSKY (TTM. 55. 591.1.)
2. *Lobaria jablonszkyi* RÁSKY (TTM. 55. 592.1.)
3. *Lobaria jablonszkyi* RÁSKY (TTM. 55. 549.1.)
4. *Lobaria jablonszkyi* RÁSKY (TTM. 63. 924.1.)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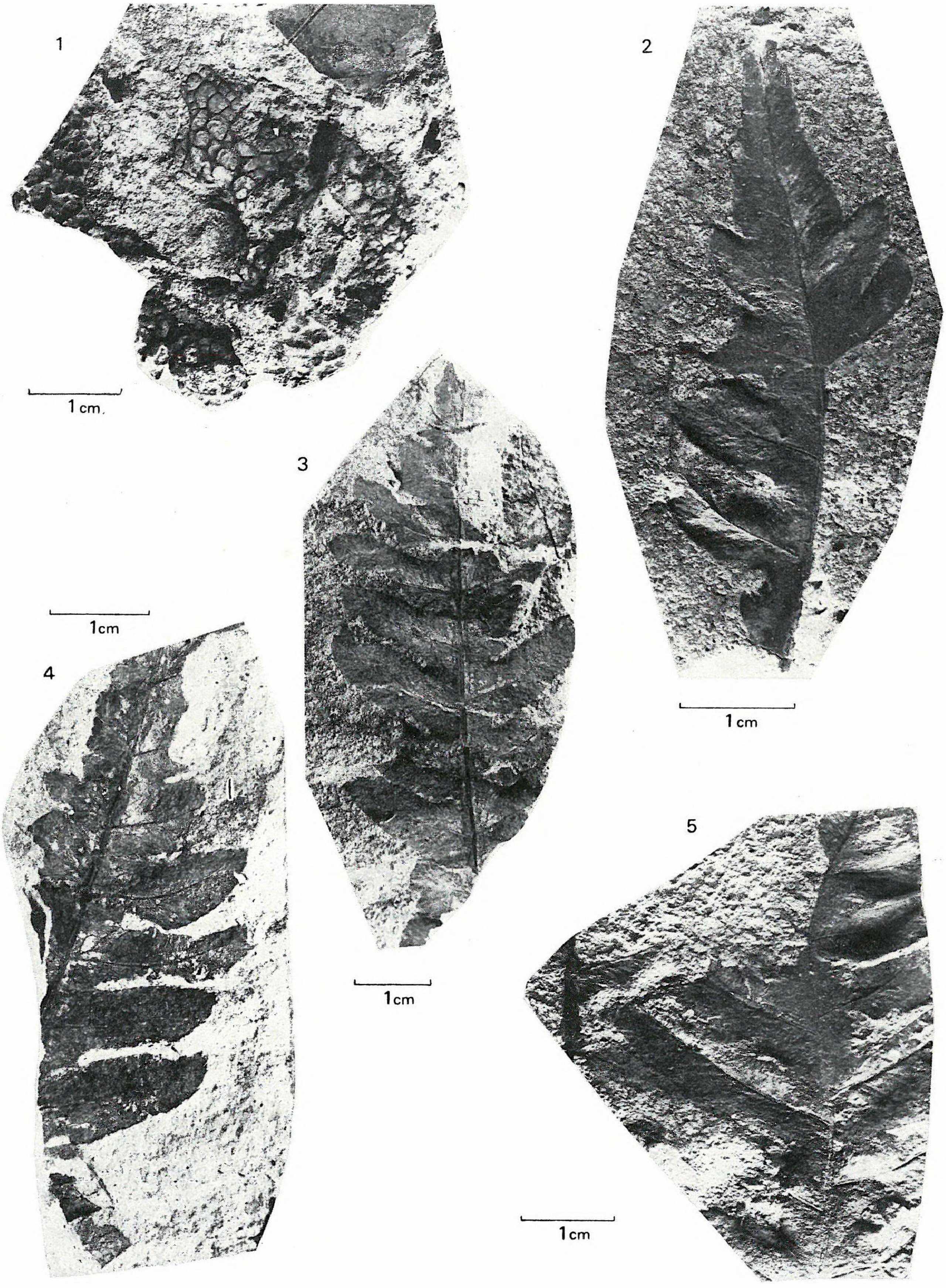
1. *Lobaria jablonszkyi* Rásky (TTM. 55. 554.1.)
2. *Woodwardia muensteriana* (Presl in Sternberg) Kräusel (TTM. 55. 1494.1.)
3. *Woodwardia muensteriana* (Presl in Sternberg) Kräusel (TTM. 55. 1492.1.)
4. *Woodwardia muensteriana* (Presl in Sternberg) Kräusel (TTM. 55. 1490.1.)
5. *Woodwardia muensteriana* (Presl in Sternberg) Kräusel (TTM. 55. 1489.2.)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1. *Pronephrium stiriacum* (UNGER) KNOBLOCH et KVAČEK (TTM. 62. 773.1.)
2. *Asplenium* sp. (TTM. 62. 779.1.)
3. *Dryopteris kümmerlei* JABLONSZKY (TTM. 62. 775.1.)
4. *Pronephrium stiriacum* (UNGER) KNOBLOCH et KVAČEK (TTM. 62. 777.1.)

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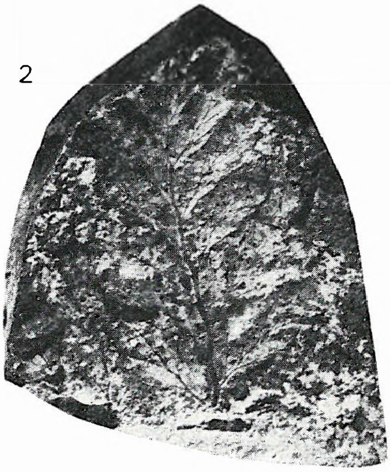

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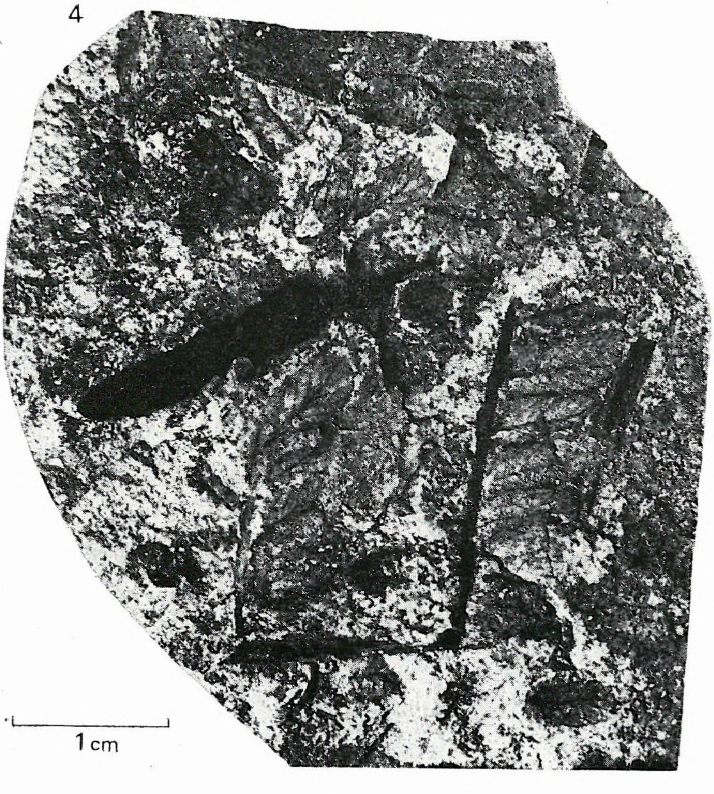

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1. *Asplenium* sp. (TTM. 62. 780.1.)
2. *Libocedrites salicornioides* (UNGER) ENDLICHER (TTM. 54. 263.1.)
3. *Libocedrites salicornioides* (UNGER) ENDLICHER (TTM. 54. 2062.1.)
4. *Libocedrites salicornioides* (UNGER) ENDLICHER (TTM. 60. 63.1.)

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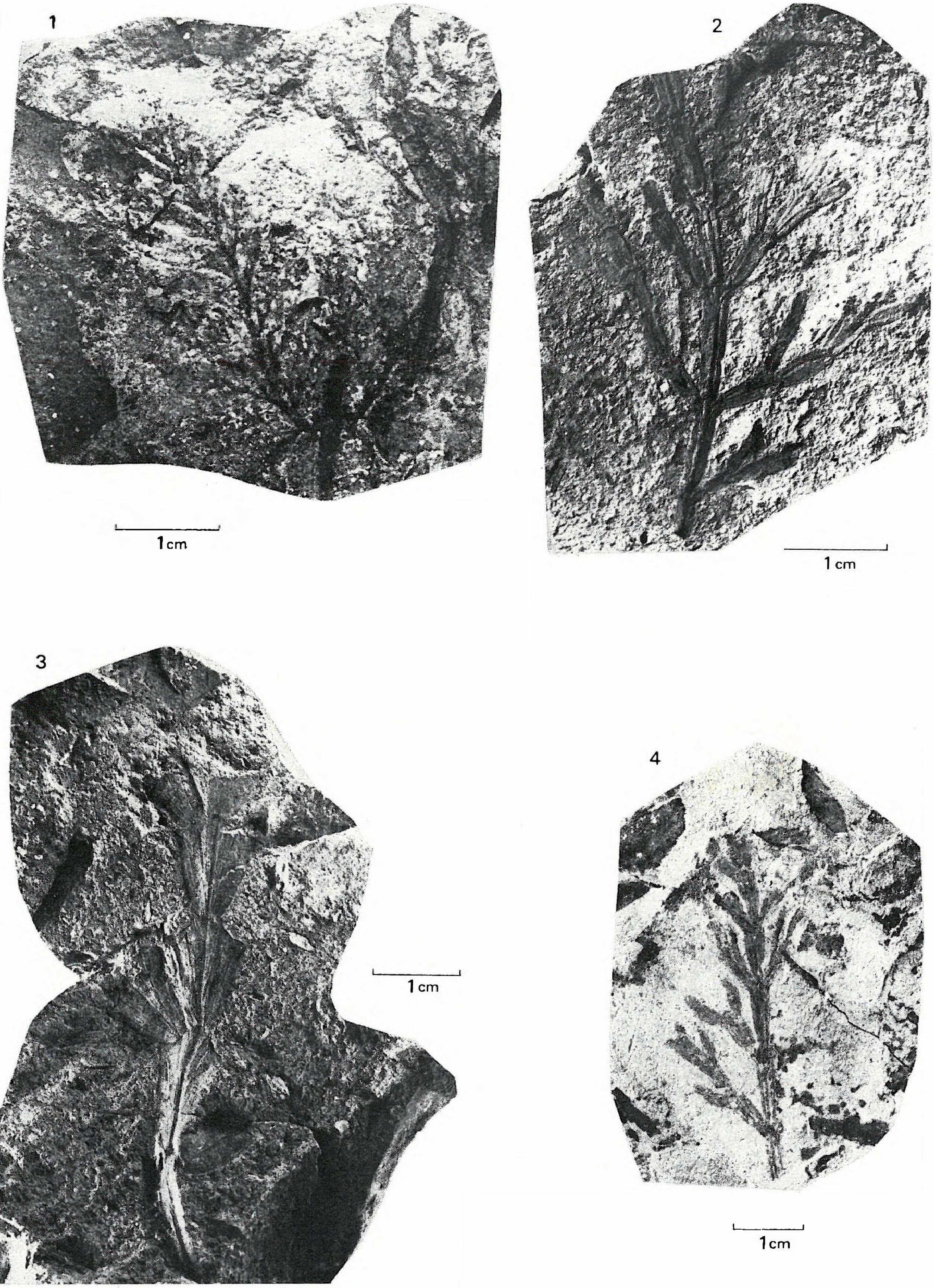

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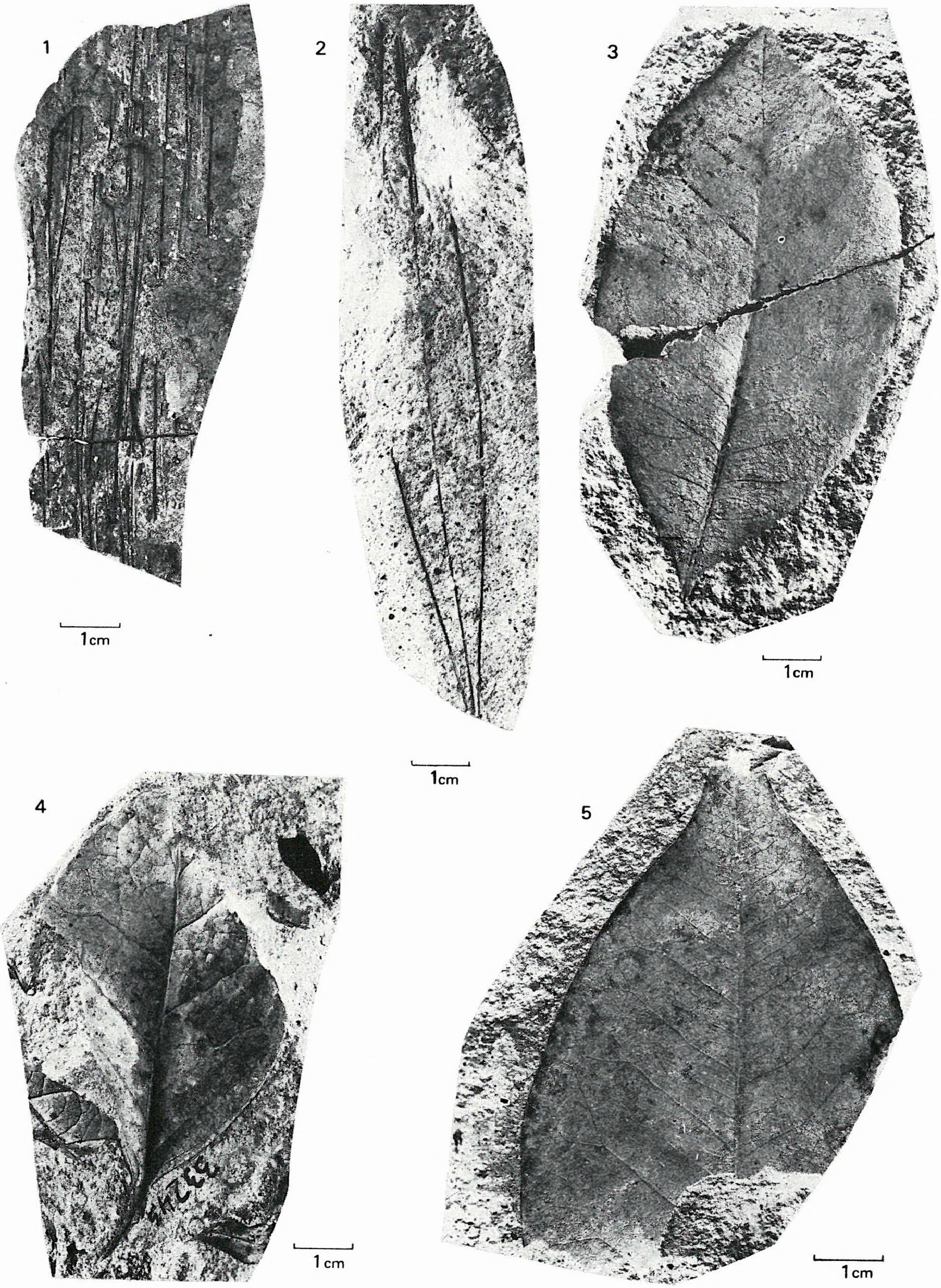
1. *Pinus saturni* UNGER (TTM. 63. 84.1.)
2. *Pinus saturni* UNGER (TTM. 63. 54.1.)
3. *Magnolia dianae* UNGER (TTM. 82. 461.1.)
4. *Magnolia dianae* UNGER (TTM. 82. 469.1.)
5. *Magnolia dianae* UNGER (TTM. 82. 462.1.)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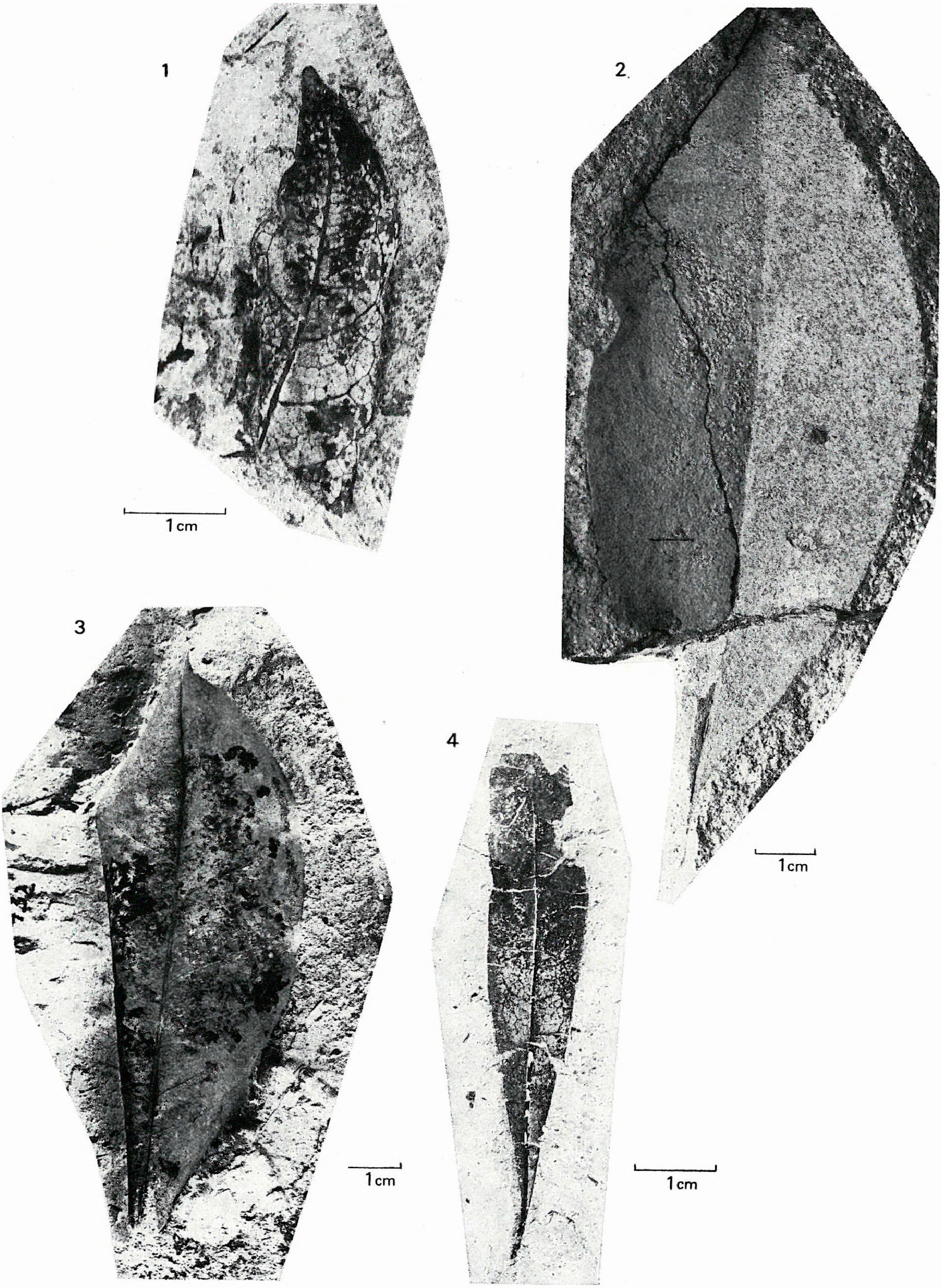
1. *Magnolia kristinae* Knobloch et Kvaček (TTM. 82. 427.1.)
2. *Magnolia dianae* Unger (TTM. 82. 467.1.)
3. *Magnolia dianae* Unger (TTM. 82. 470.1.)
4. *Magnolia kristinae* Knobloch et Kvaček (TTM. 82. 428.1.)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1. *Magnolia mirabilis* KOLAKOVSZKIJ (TTM. 82. 379.1.)
2. *Magnolia mirabilis* KOLAKOVSZKIJ + *Laurus princeps* HEER (TTM. 82. 223.1.)
3. *Magnolia mirabilis* KOLAKOVSZKIJ + *Laurus princeps* HEER (TTM. 63. 188.1.)
4. *Persea braunii* HEER (MÁFI. 224.)

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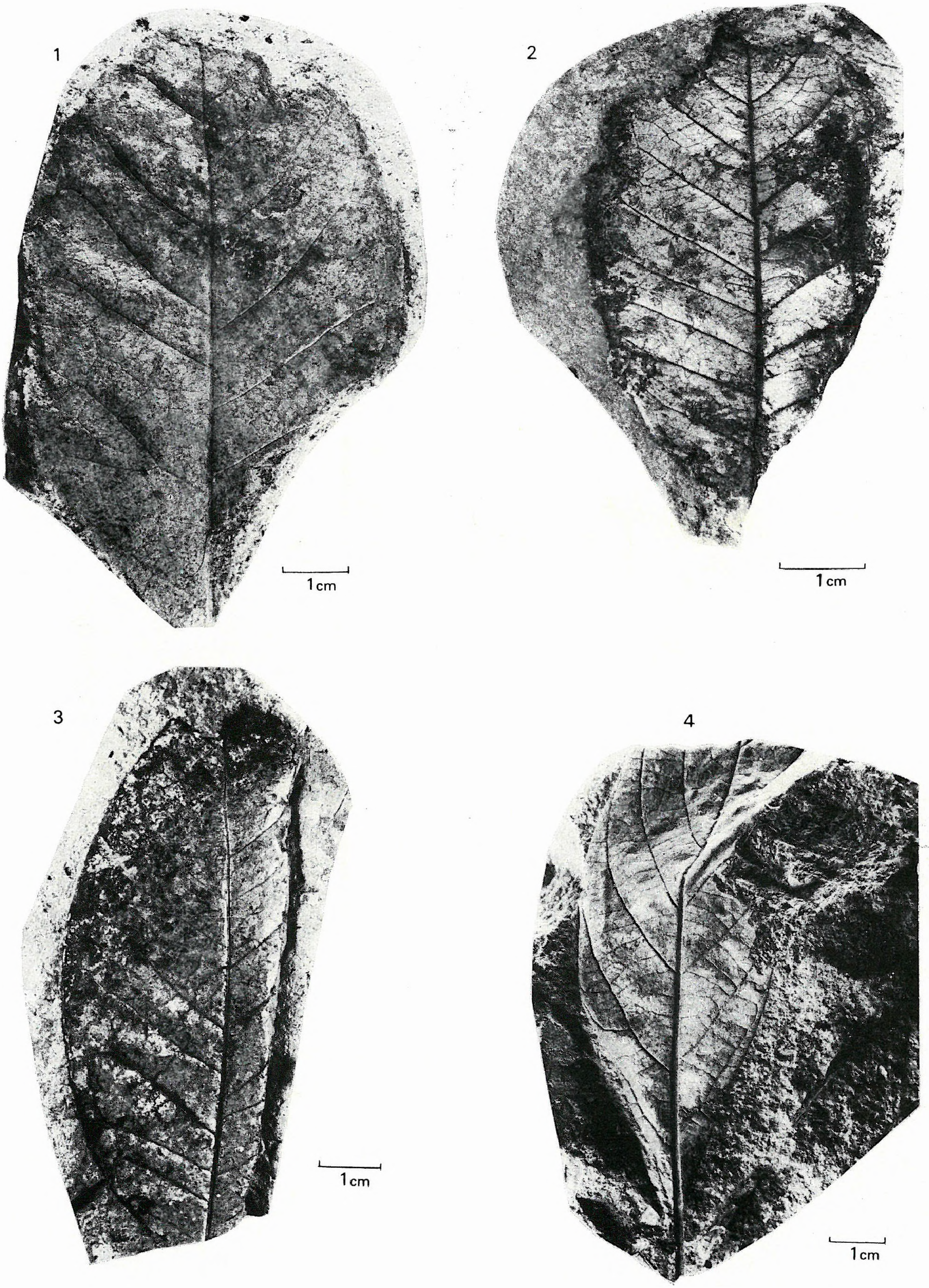
1. *Persea braunii* HEER (MÁFI. 220.)
2. *Persea braunii* HEER (MÁFI. 221.)
3. *Persea braunii* HEER (TTM. 82. 395.1.)
4. *Persea speciosa* HEER (TTM. 82. 390.1.)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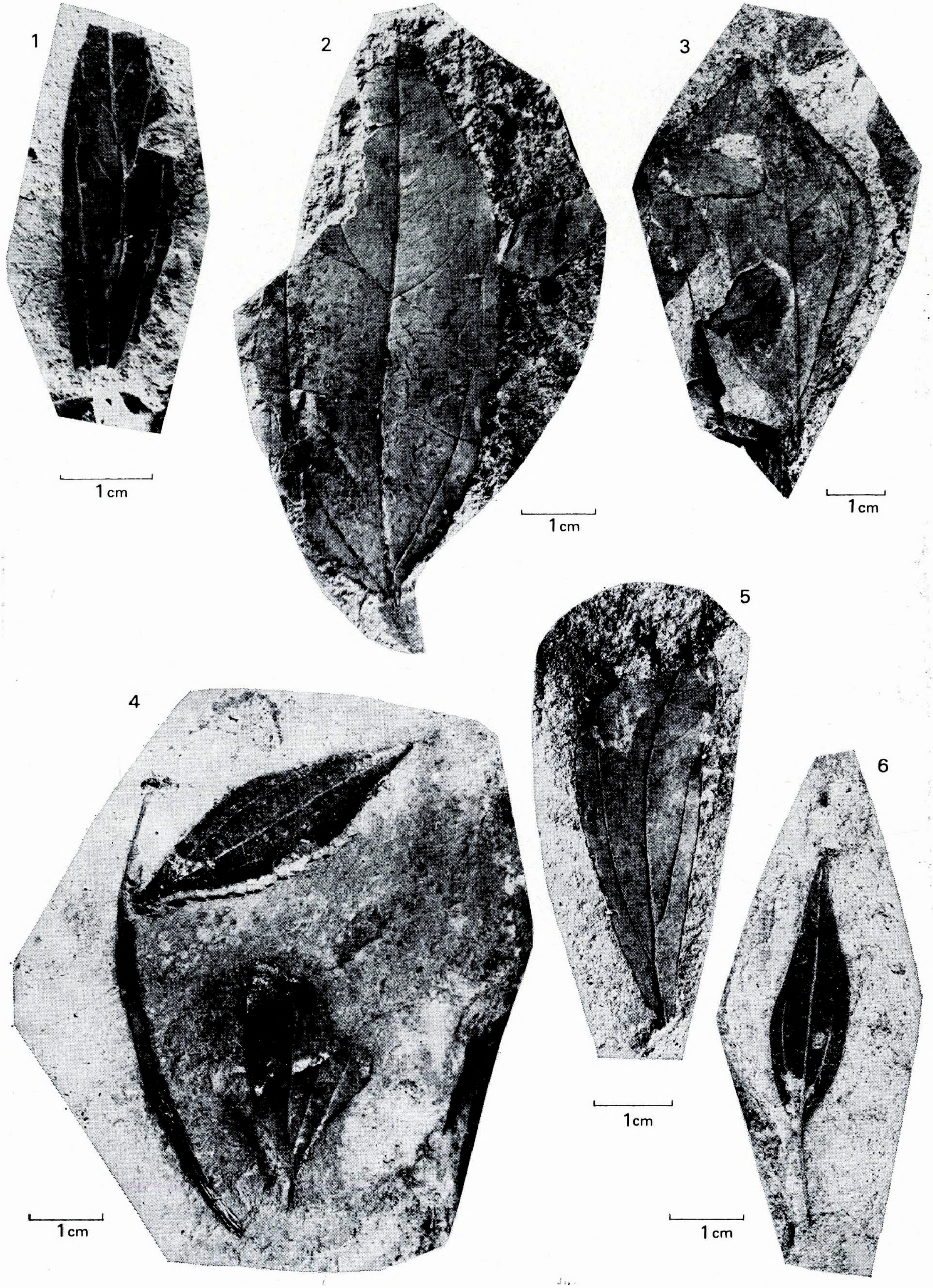
1. *Daphnogene bilinica* (Unger) Kvaček et Knobloch (TTM. 53. 111.1.)
2. *Daphnogene cinnamomeifolia* (Brogniart) Bronn (TTM. 53. 122.1.)
3. *Daphnogene cinnamomeifolia* (Brogniart) Bronn (TTM. 56. 526.1.)
4. *Daphnogene bilinica* (Unger) Kvaček et Knobloch (TTM. 53. 75.1.)
5. *Daphnogene bilinica* (Unger) Kvaček et Knobloch (TTM. 54. 503.1.)
6. *Daphnogene bilinica* (Unger) Kvaček et Knobloch (TTM. 53. 164.1.)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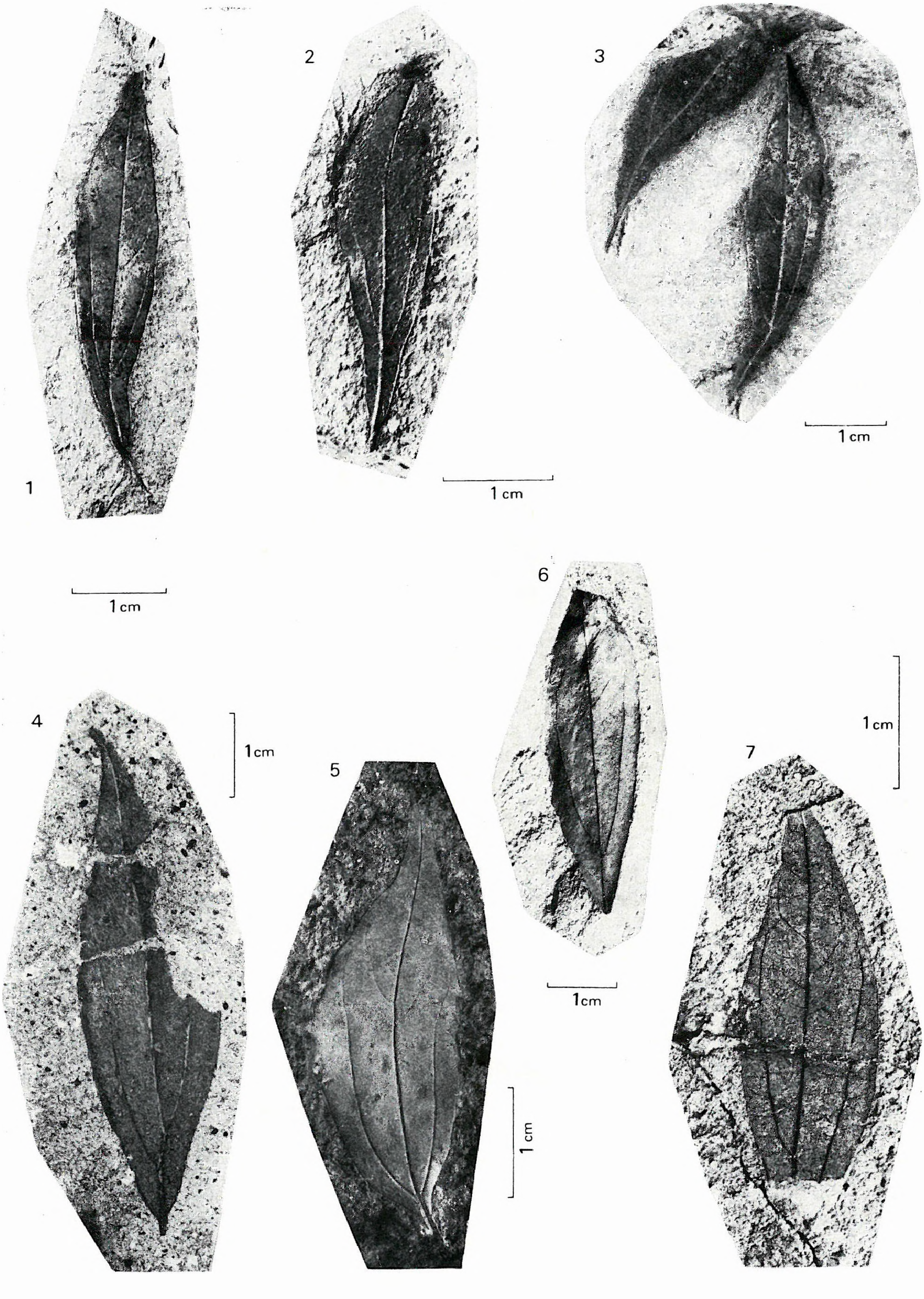
1. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 48.1.)
2. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 44.1.)
3. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 52.1.)
4. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 182.1.)
5. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 188.1.)
6. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 21.1.)
7. *Daphnogene bilinica* (UNGER) KVAČEK et KNOBLOCH (TTM. 53. 157.1.)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1. *Daphnogene polymorpha* (A. BRAUN) ETTINGSHAUSEN (TTM. 56. 511.1.)
2. *Daphnogene polymorpha* (A. BRAUN) ETTINGSHAUSEN (TTM. 56. 517.1.)
3. *Daphnogene polymorpha* (A. BRAUN) ETTINGSHAUSEN (TTM. 56. 520.3.)
4. *Daphnogene polymorpha* (A. BRAUN) ETTINGSHAUSEN (TTM. 56. 524.1.)
5. *Daphnogene spectabile* (HEER) KNOBLOCH (TTM. 56. 541.1.)

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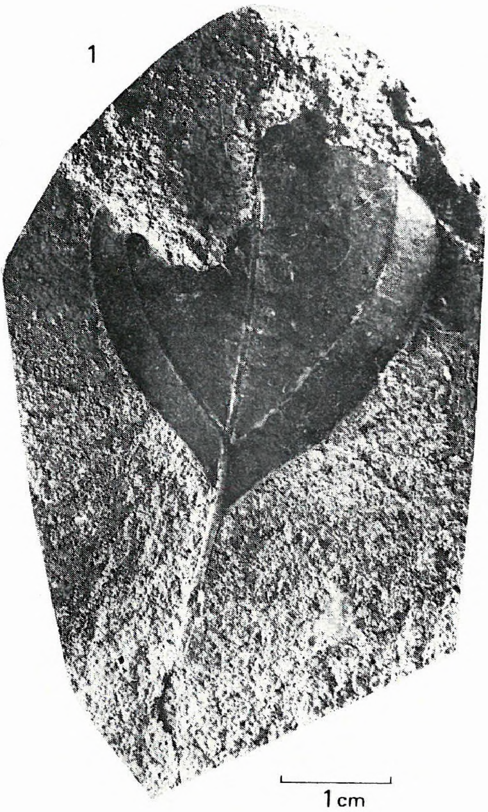

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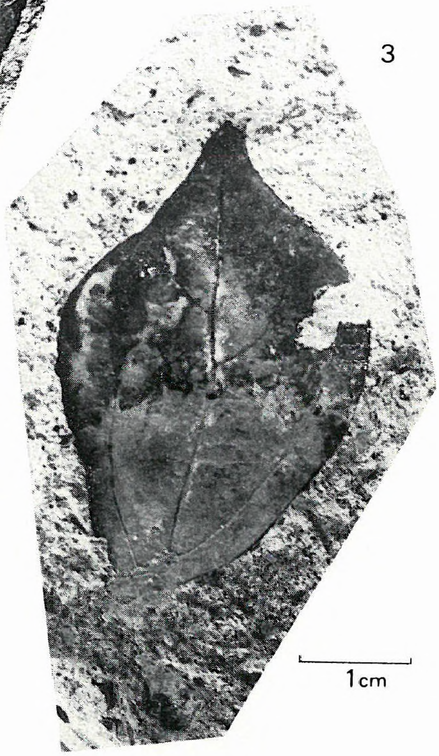

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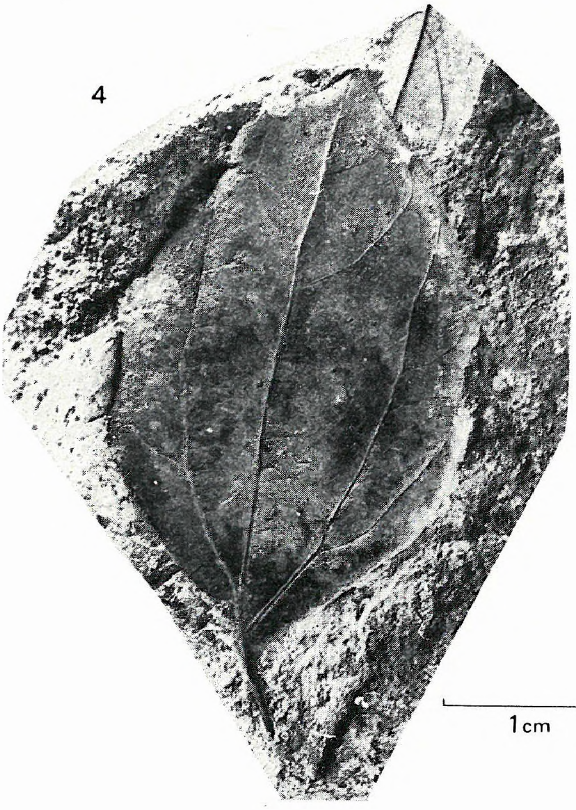

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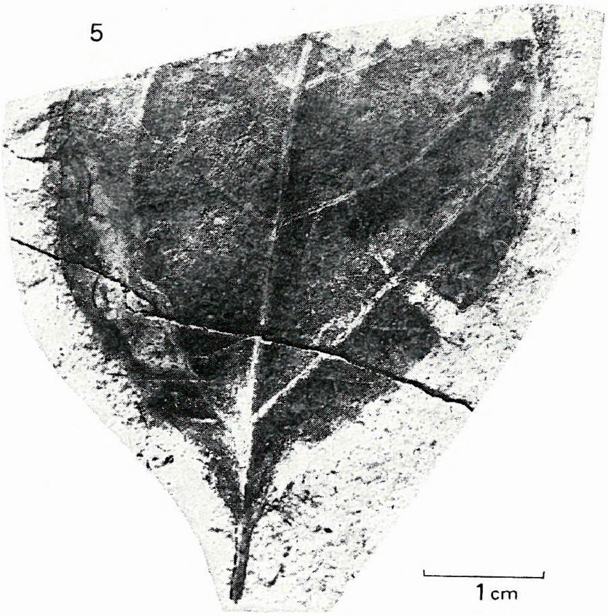

1. *Litsea ipolytarnocense* n. sp. (TTM. 82. 296.1.)
2. *Daphnogene spectabile* (Heer) Knobloch (TTM. 53. 116.1.)
3. *Daphnogene spectabile* (Heer) Knobloch (TTM. 56. 537.1.)
4. *Litsea ipolytarnocense* n. sp. (TTM. 82. 259.1.)

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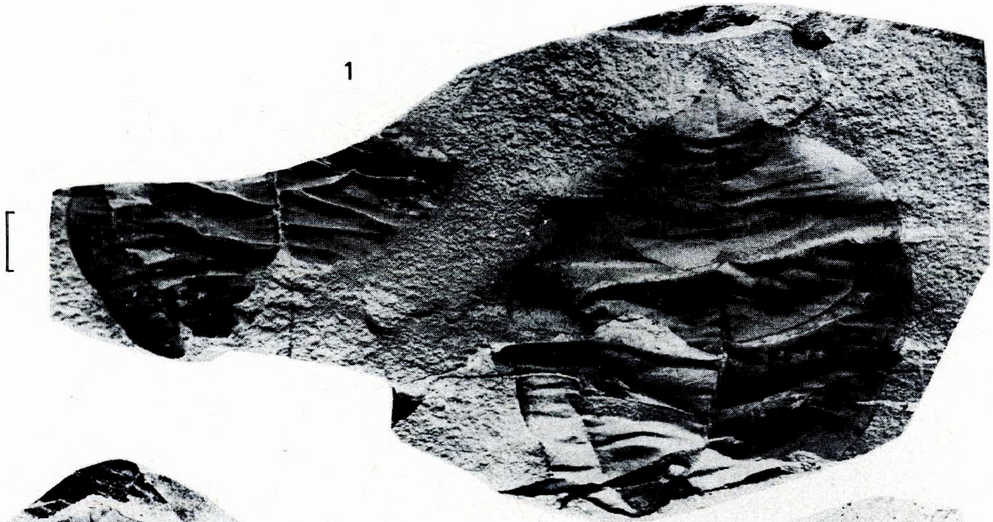

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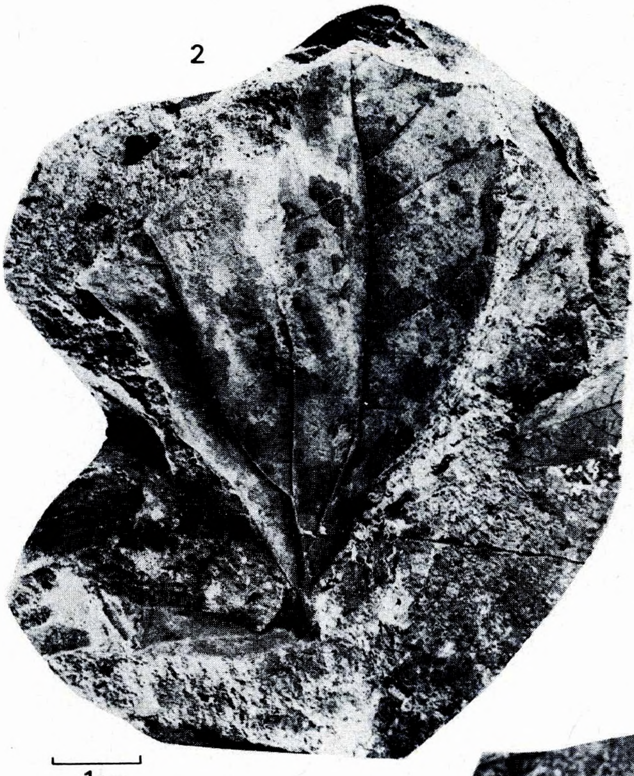

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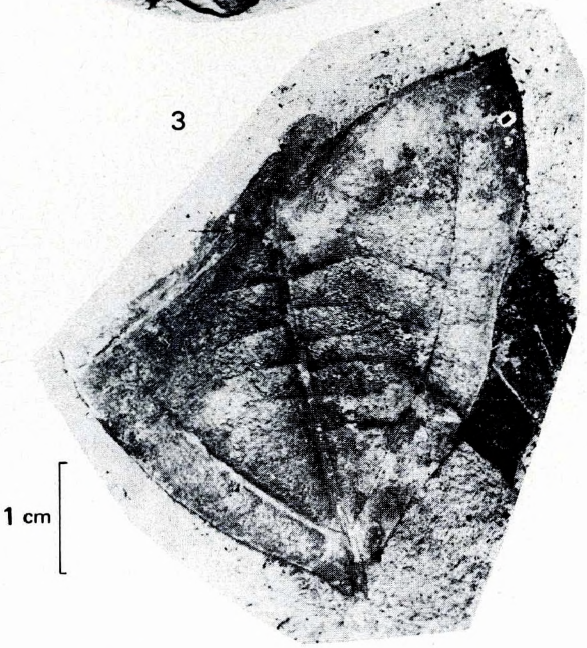

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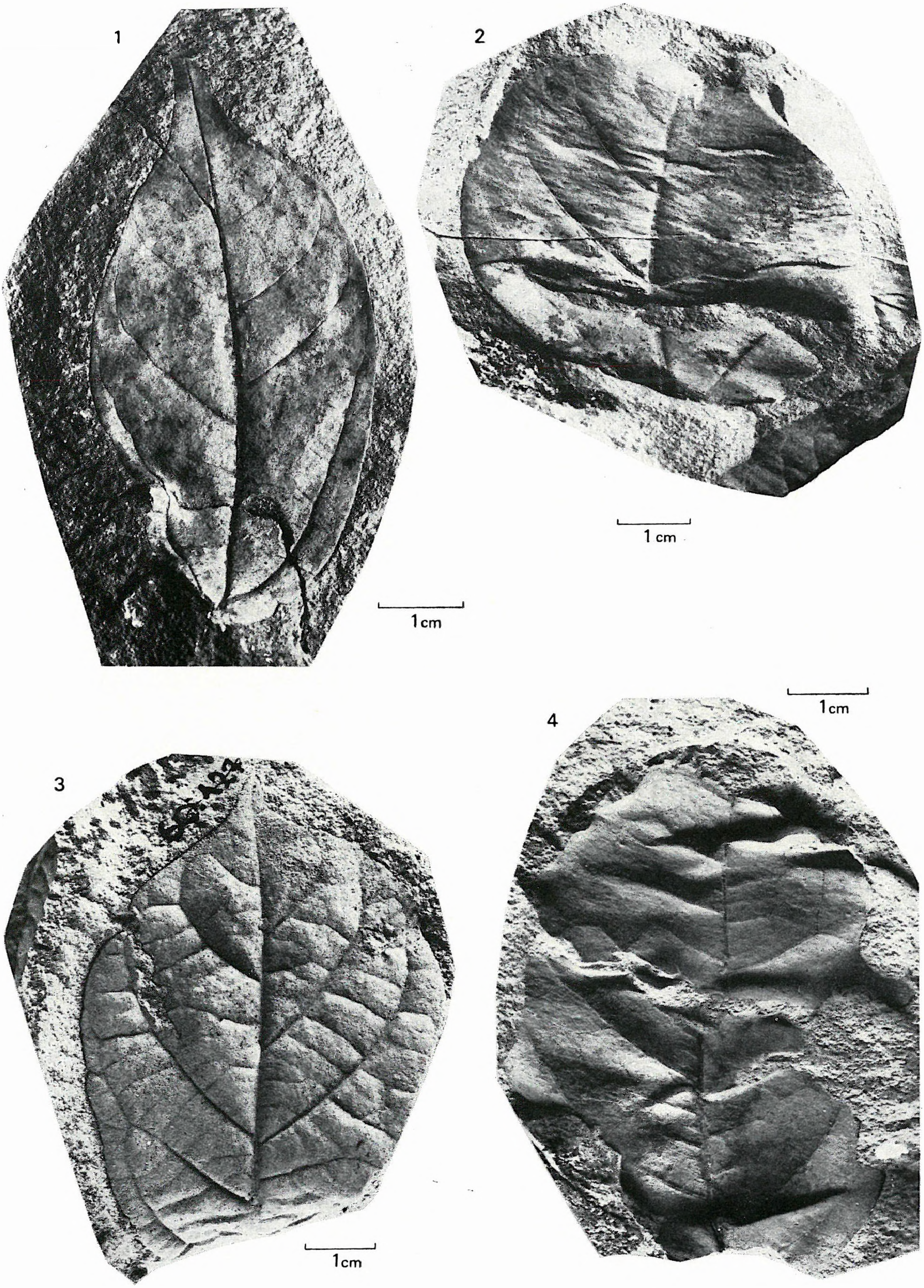
1. *Litsea ipolytarnocense* n. sp. (TTM. 82. 419.1.)
2. *Litsea ipolytarnocense* n. sp. (TTM. 82. 302.1.)
3. *Litsea ipolytarnocense* n. sp. (KFM. 60. 127.1.)
4. *Litsea ipolytarnocense* n. sp. (KFM. 82. 300.1.)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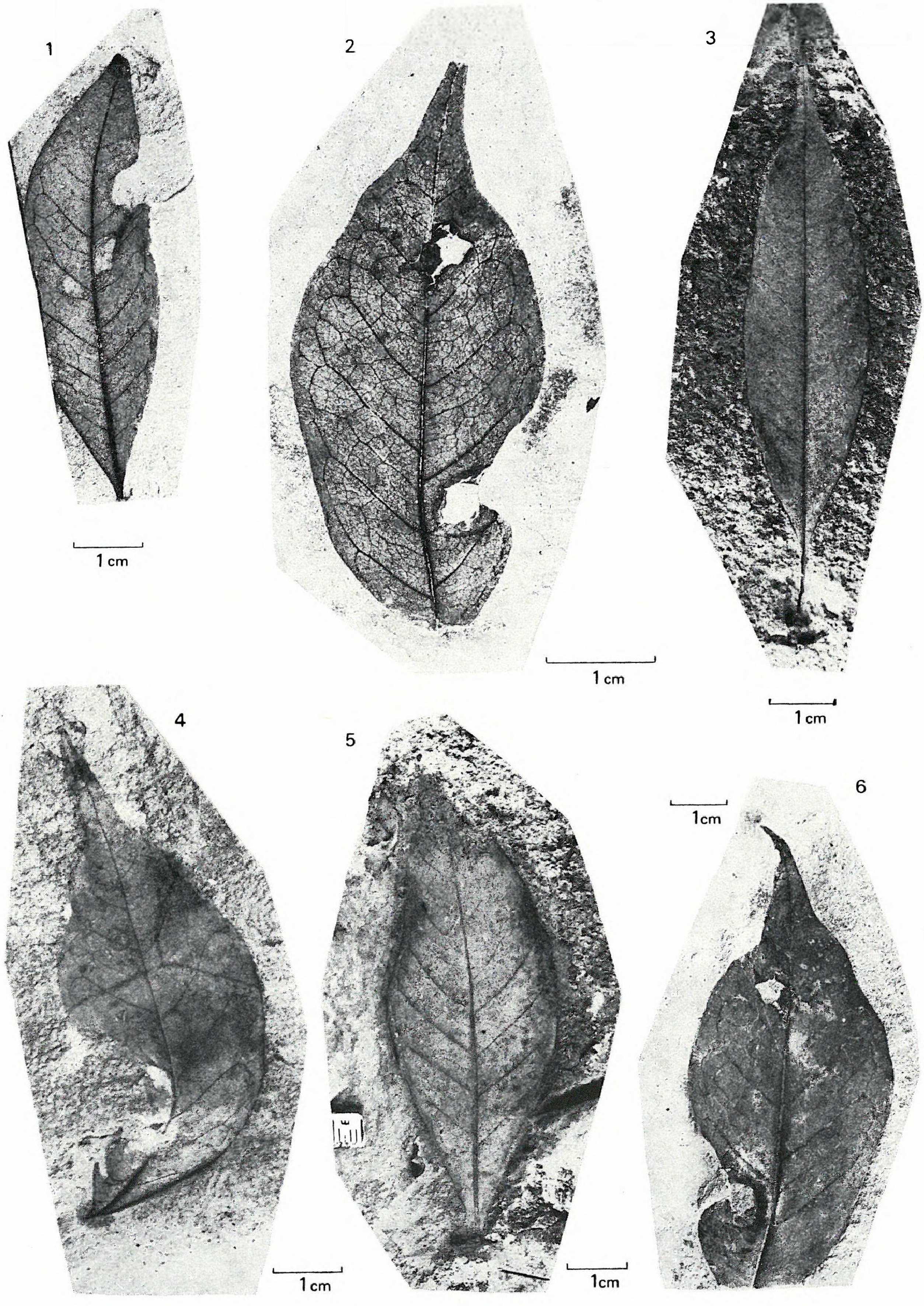
1. *Laurus princeps* HEER (TTM. 82. 371.1.)
2. *Laurus princeps* HEER (TTM. 82. 407.1.)
3. *Laurus princeps* HEER (TTM. 82. 372.1.)
4. *Laurus princeps* HEER (TTM. 82. 331.1.)
5. *Laurus princeps* HEER (TTM. 82. 367.1.)
6. *Laurus princeps* HEER (TTM. 82. 322.1.)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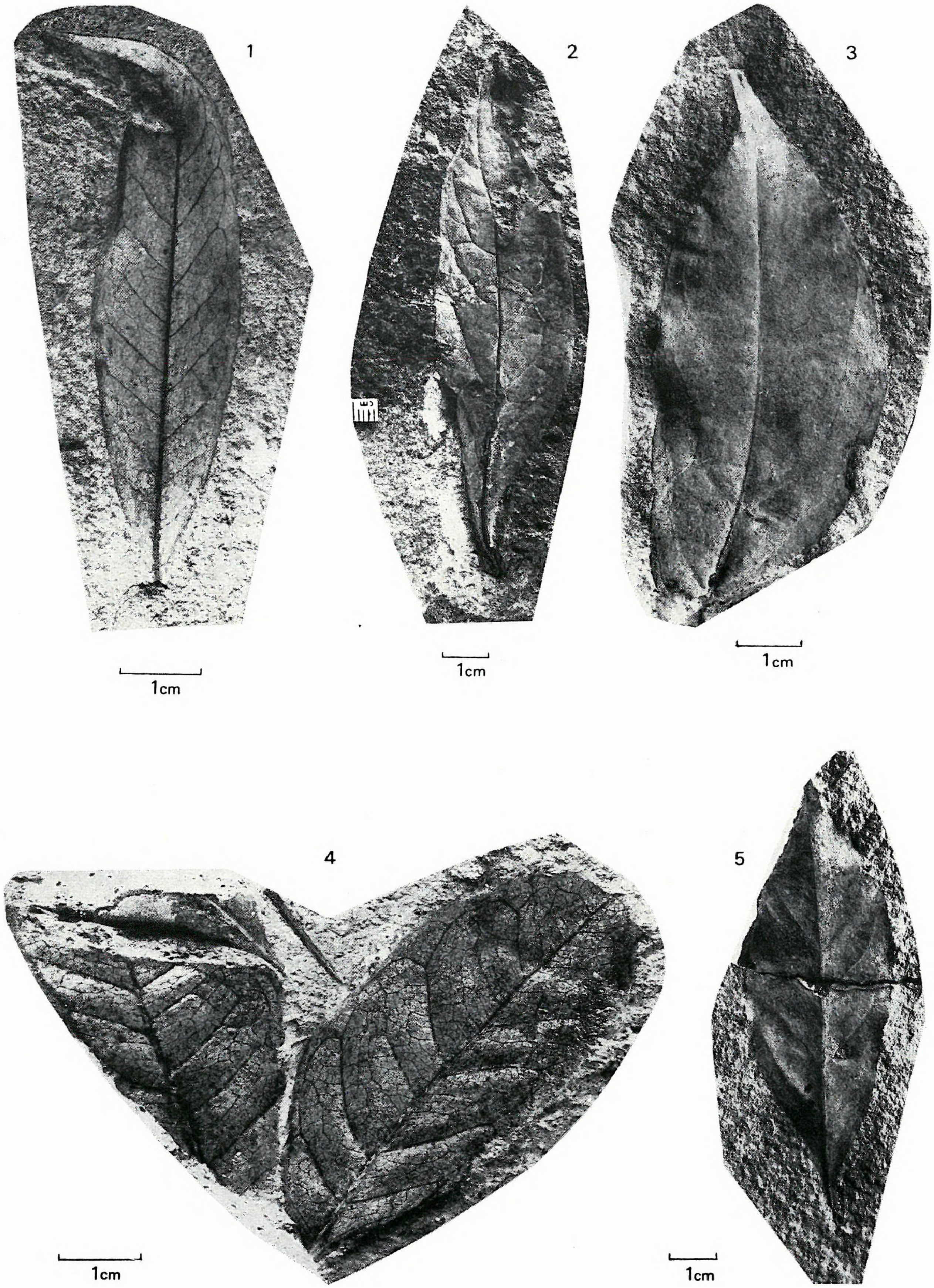
1. *Laurus princeps* Heer (TTM. 82. 308.1.)
2. "*Laurus*" *primigenia* Unger, 1850 sensu Weyland 1934 (TTM. 82. 412.1.)
3. *Laurophyllum heeri* (Ettingshausen) Němejc et Knobloch (TTM. 65. 1.1.)
4. *Laurus princeps* Heer (TTM. 82. 333.1.)
5. "*Laurus*" *primigenia* Unger, 1850 sensu Weyland 1934 (TTM. 82. 410.1.)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1. *Laurophyllum heeri* (Ettingshausen) Němejc et Knobloch (TTM. 82. 432.1.)
2. *Laurophyllum heeri* (Ettingshausen) Němejc et Knobloch (TTM. 82. 440.1.)
3. *Laurophyllum heeri* (Ettingshausen) Němejc et Knobloch (TTM. 65. 9.1.)
4. *Laurophyllum heeri* (Ettingshausen) Němejc et Knobloch (TTM. 65. 2.1.)

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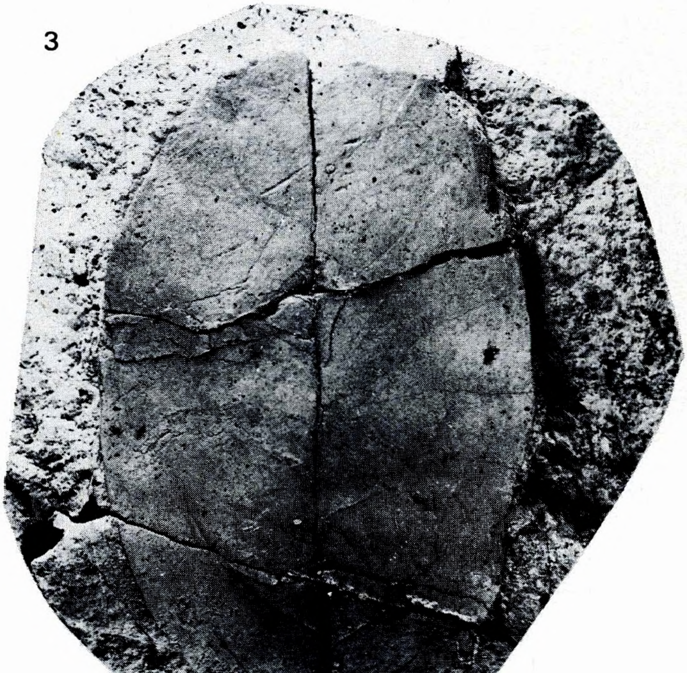

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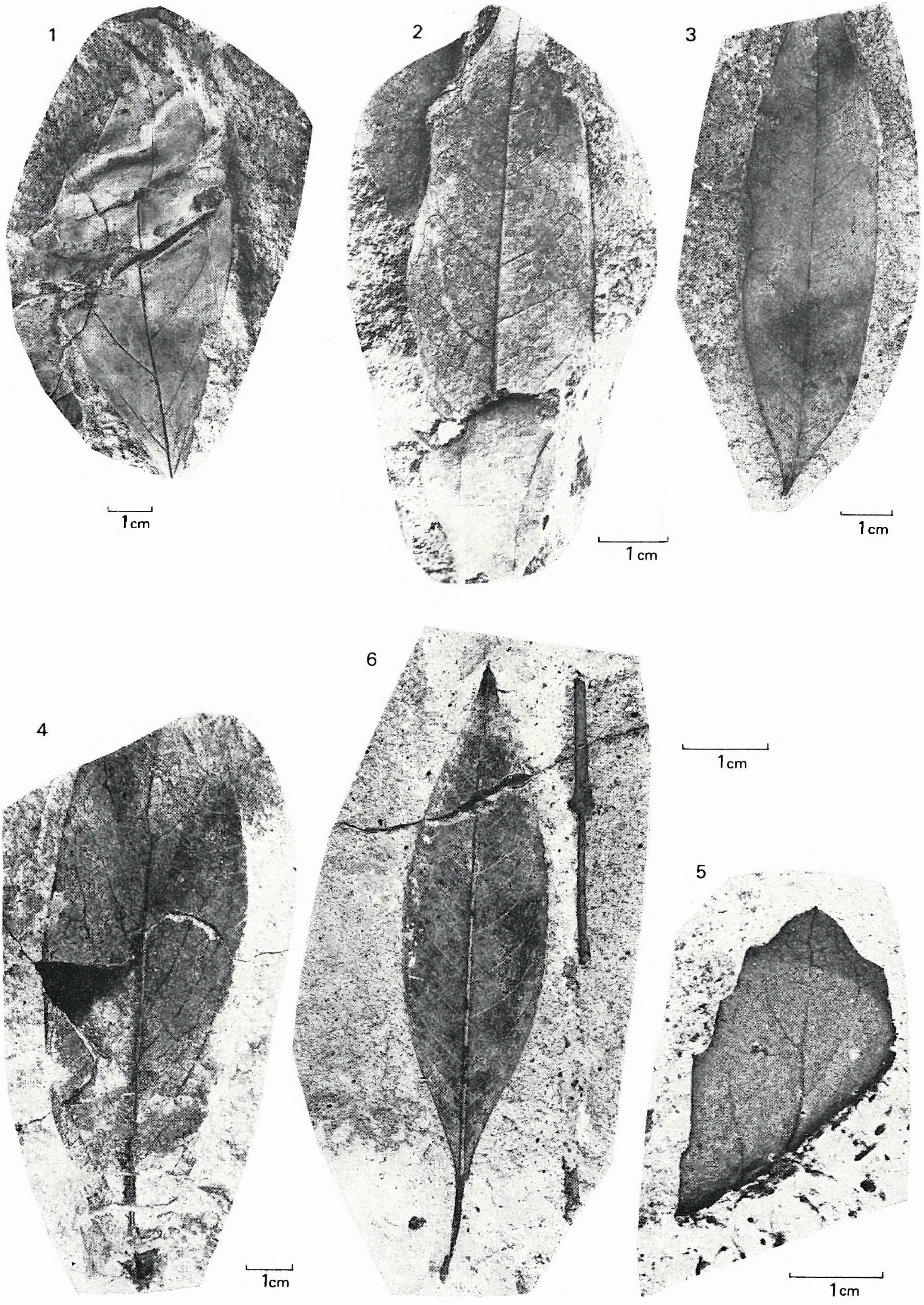
1. *Laurophyllum heeri* (ETTINGSHAUSEN) NĚMEJC et KNOBLOCH (TTM. 82. 443.1.)
2. *Laurophyllum pseudoprinceps* WEYLAND et KLIPPER (TTM.)
3. *Laurophyllum pseudoprinceps* WEYLAND et KLIPPER (TTM. 82. 457.1.)
4. *Laurophyllum* cf. *villense* (WEYLAND et KLIPPER) KVAČEK et BŮŽEK (TTM. 82. 237.1.)
5. *Mahonia* sp. (TTM. 82. 383.1.)
6. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK (TTM. 82. 37.1.)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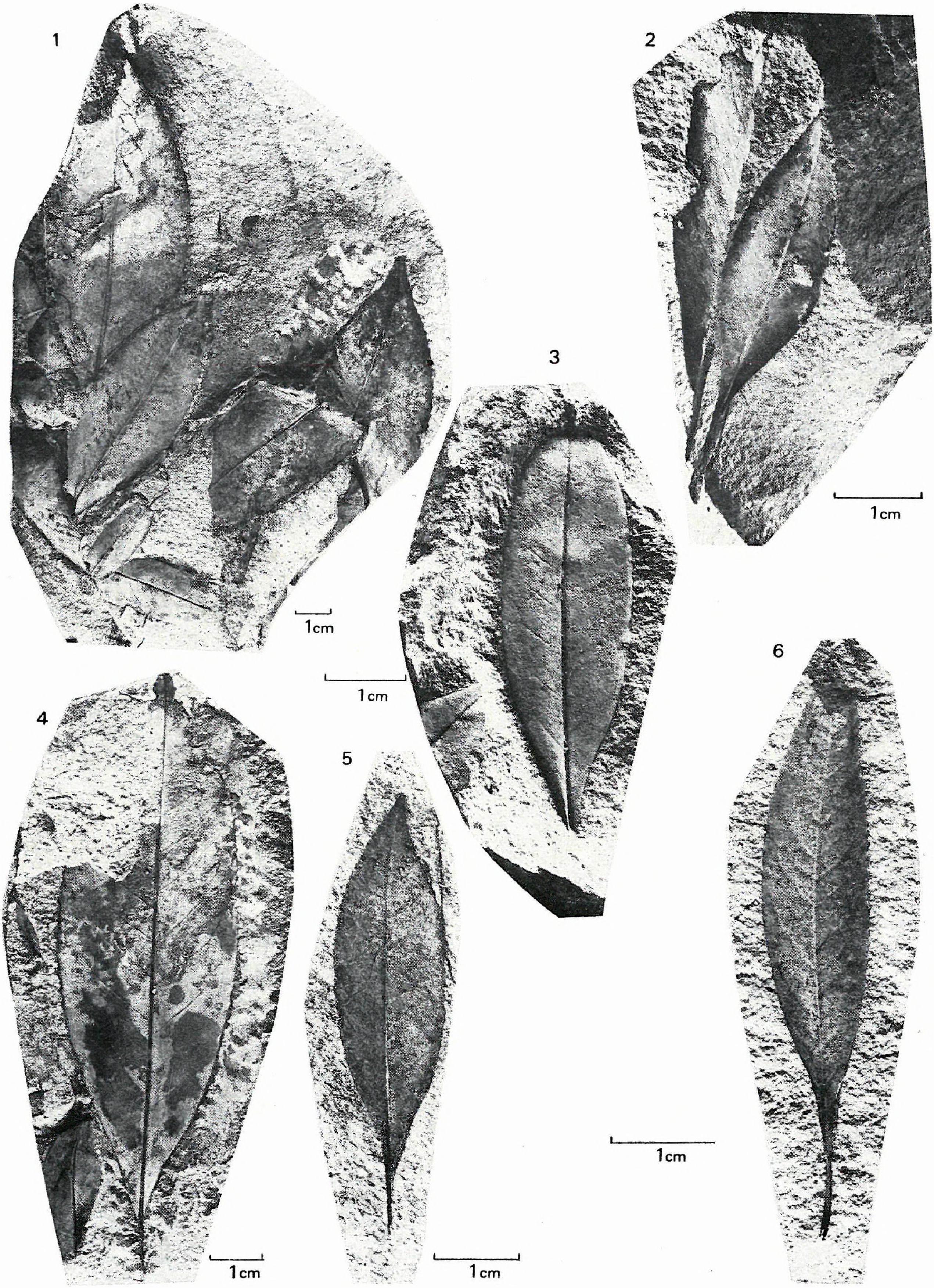
1. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 35.1.)
2. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 154.1.)
3. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 146.1.)
4. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 34.1.)
5. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 118.1.)
6. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 54. 1252.1.)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1. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 123.1.)
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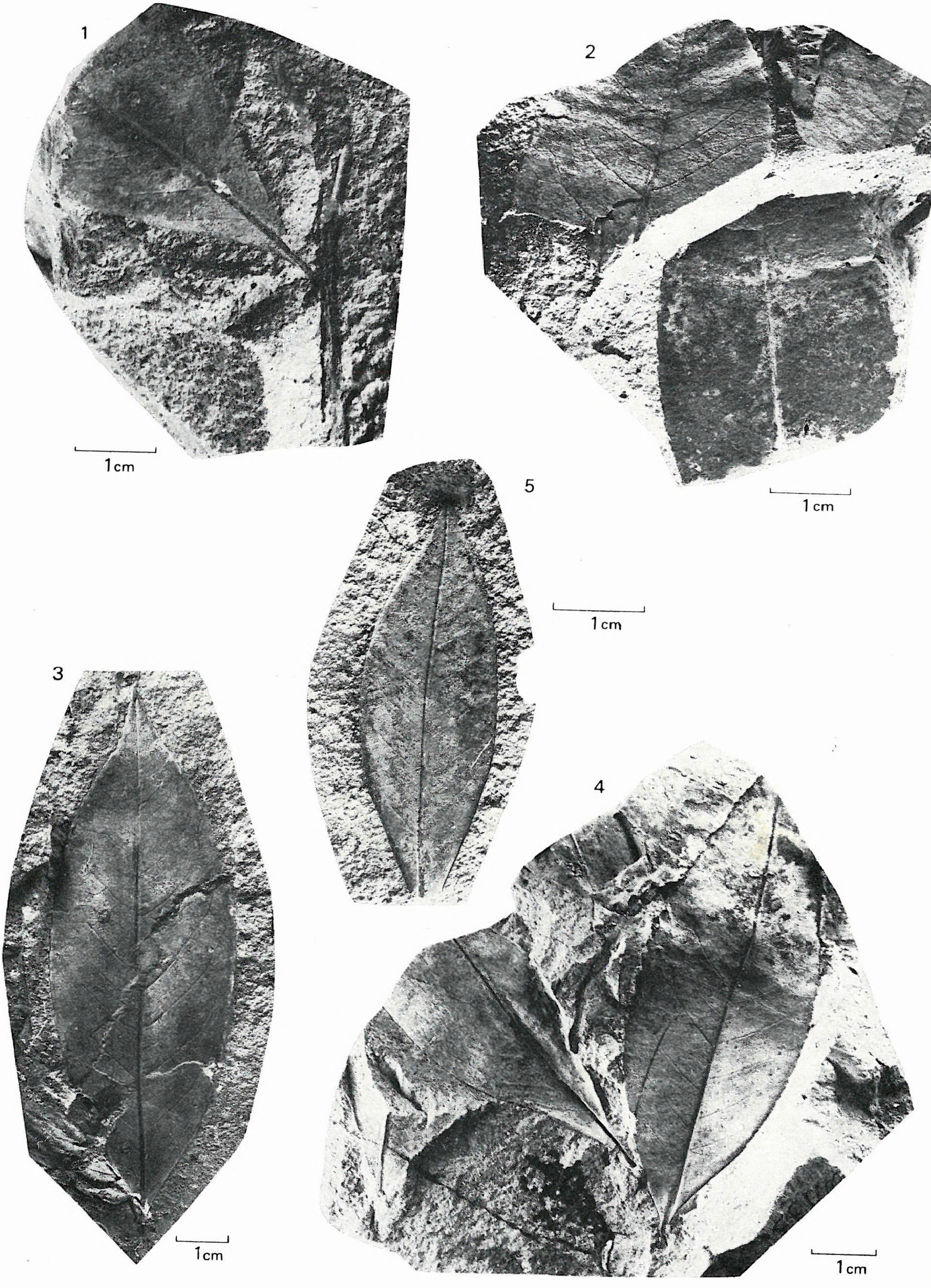
3. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 114.1.)
4. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 11.1.)
5. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 6.1.)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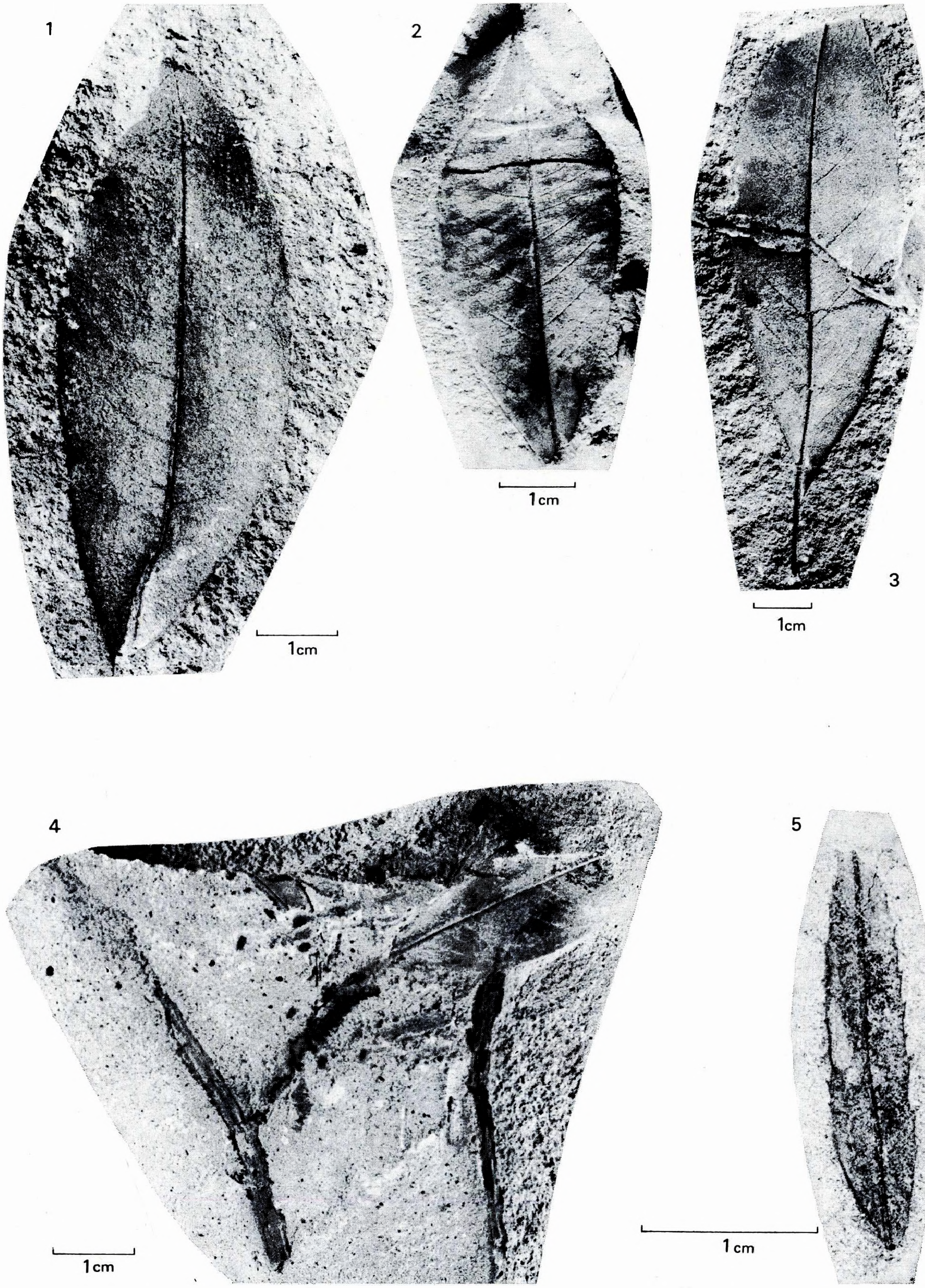
1. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK (TTM. 82. 3.1.)
2. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK (TTM. 82. 31.1.)
3. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK (TTM. 82. 107.1.)
4. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK—HOLÝ—KVAČEK (TTM. 82. 110.1.)
5. *Engelhardtia orsbergensis* (WESSEL et WEBER) JÄHNICHEN—MAI—WALTER (TTM. 56. 995.1.)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1. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 66.1.)
2. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 109.1.)
3. *Platanus neptuni* (Ettingshausen) Bůžek—Holý—Kvaček (TTM. 82. 115.1.)

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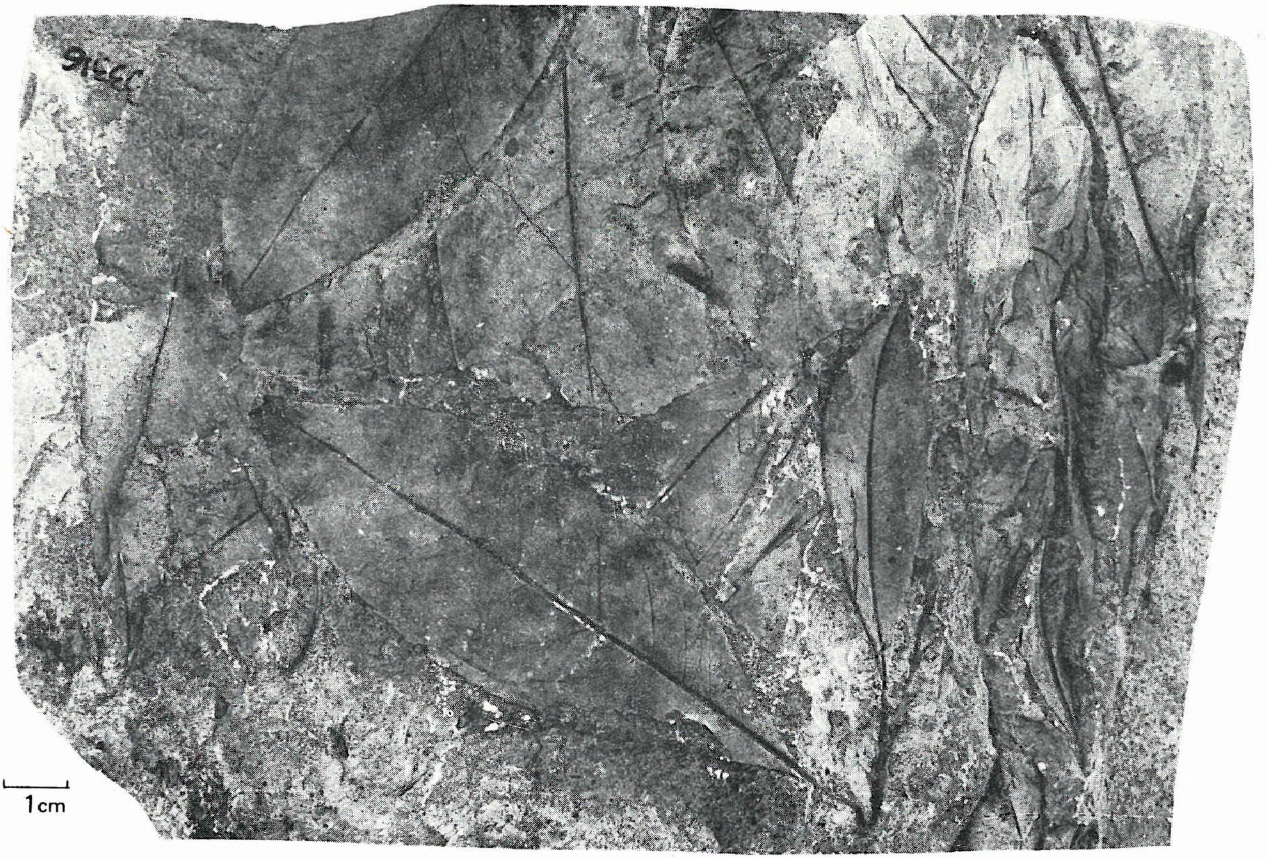

1. "*Quercus*" *cruciata* A. Braun (TTM. 63. 190.1.)
2. "*Quercus*" *cruciata* A. Braun (TTM. 63. 201.1.)
3. "*Quercus*" *cruciata* A. Braun (TTM. 63. 197.1.)
4. "*Quercus*" *cruciata* A. Braun (TTM. 63. 189.1.)

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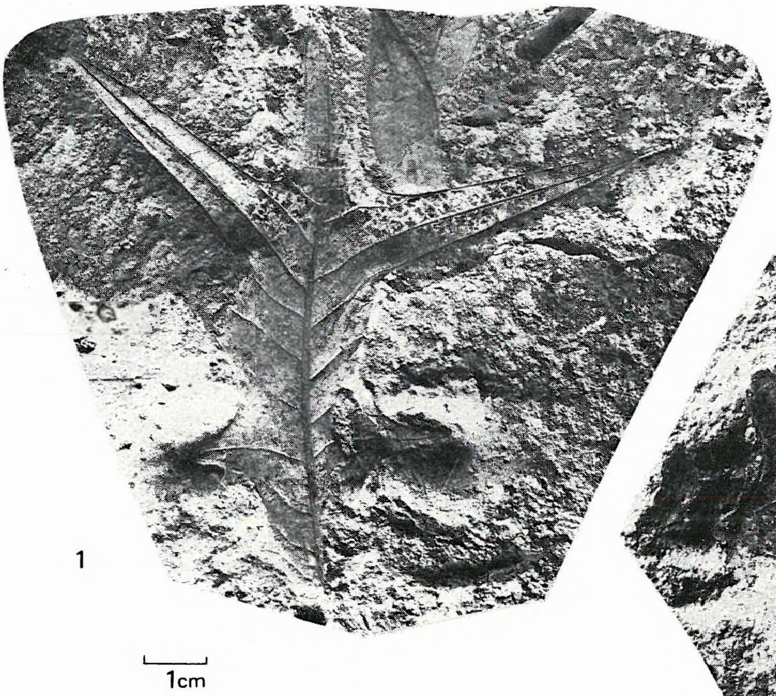

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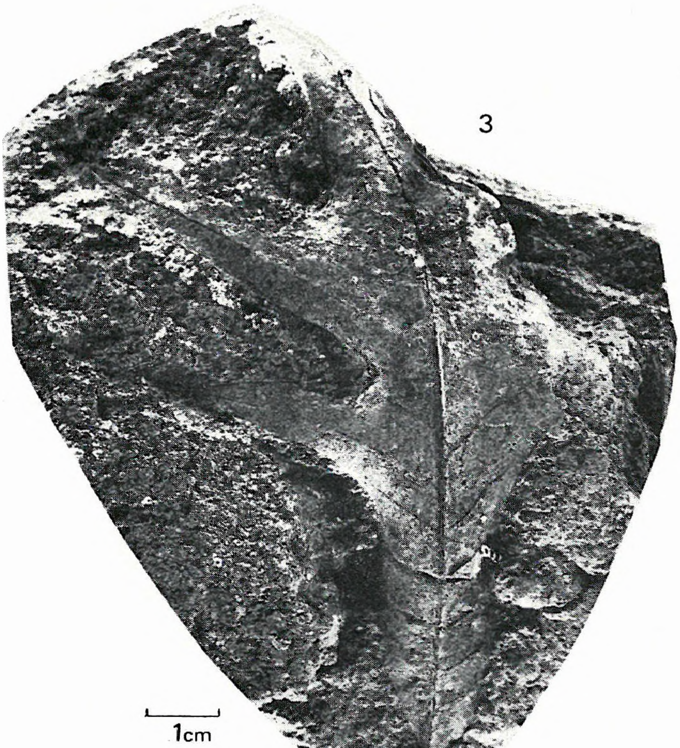

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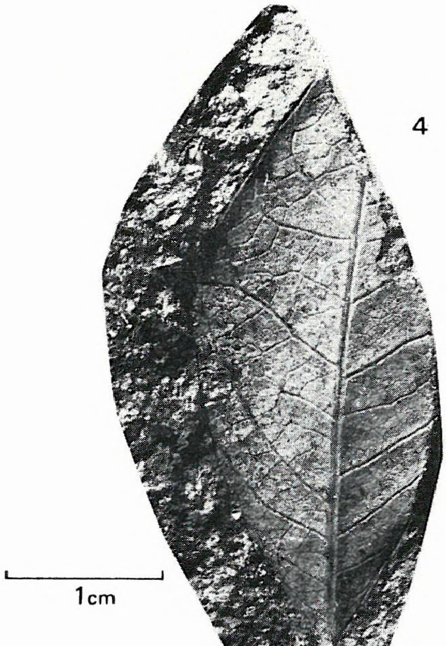
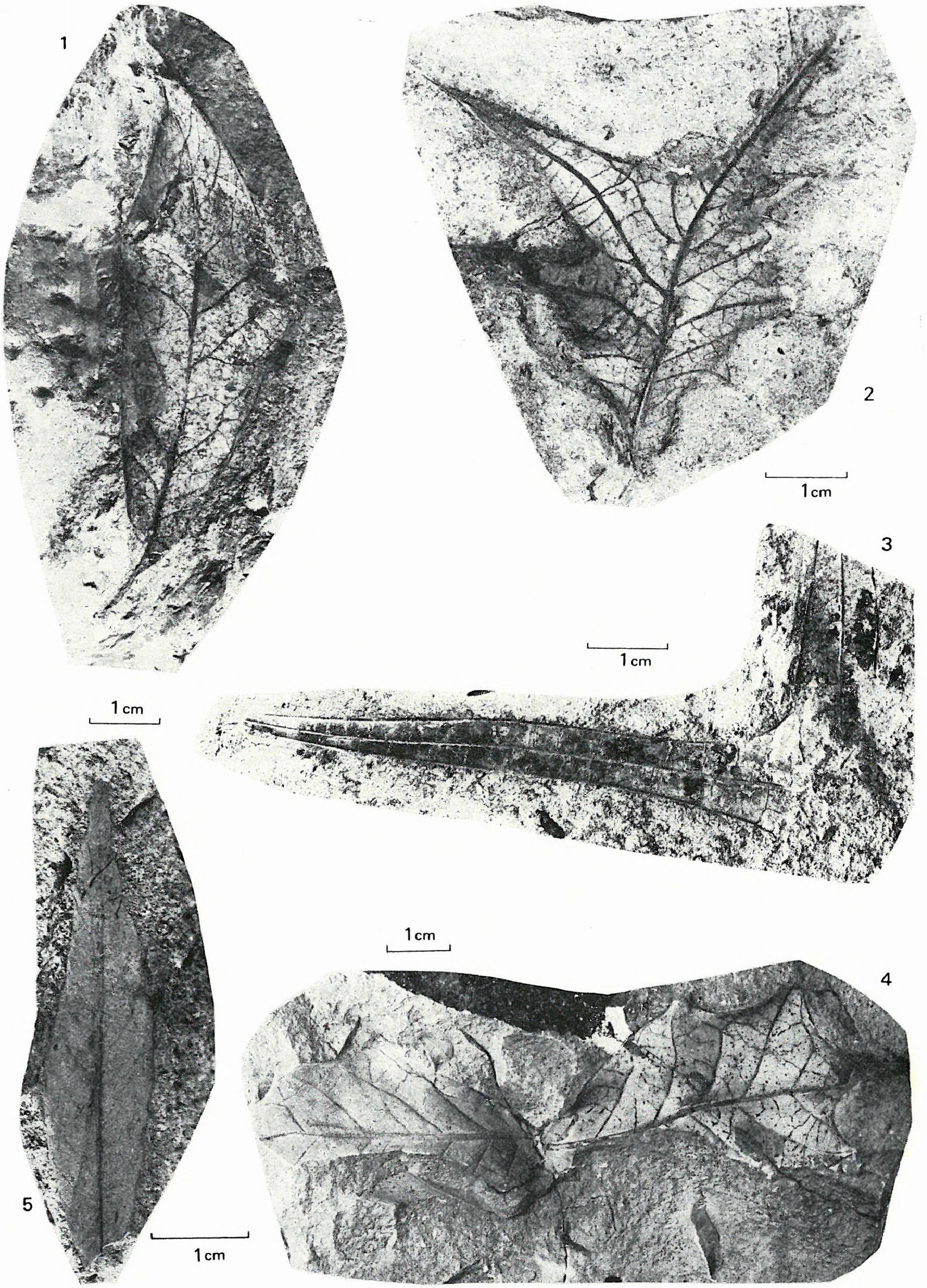


1. "*Quercus*" *cruciata* A. Braun (TTM. 63. 188.1.)
2. "*Quercus*" *cruciata* A. Braun (TTM. 63. 142.1.)
3. "*Quercus*" *cruciata* A. Braun (TTM. 63. 198.1.)
4. "*Quercus*" *cruciata* A. Braun (TTM. 63. 264.1.)
5. *Dryophyllum furcinerve* (Rossmäsler) Schmalhausen (TTM. 54. 1245.1.)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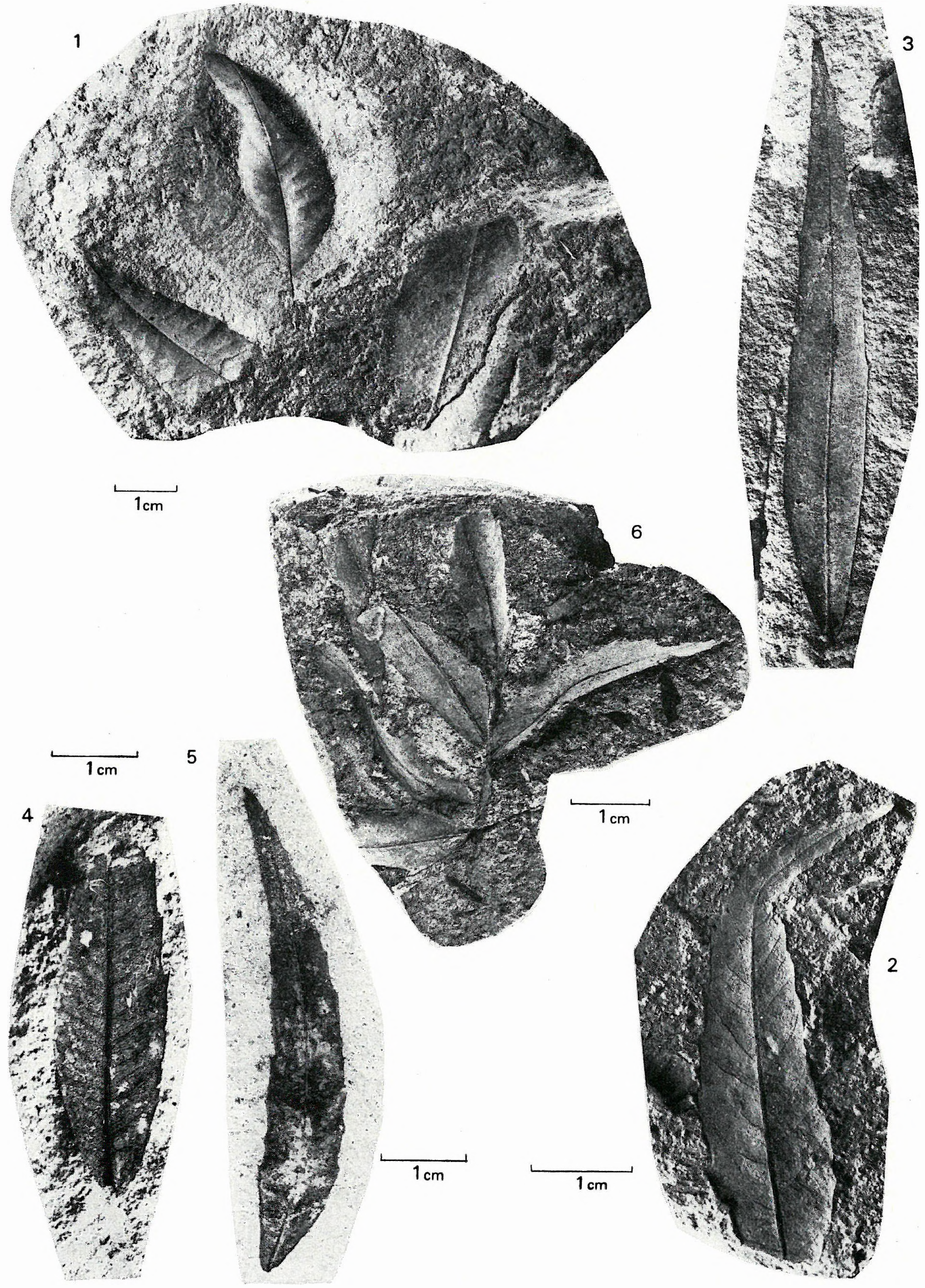
1. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1005.1.)
2. *Dryophyllum furcinerve* (Rossmäsler) Schmalhausen (TTM. 54. 1969.1.)
3. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 54. 1230.1.)
4. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 1005.1.)
5. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 890.1.)
6. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 54. 2025.1.)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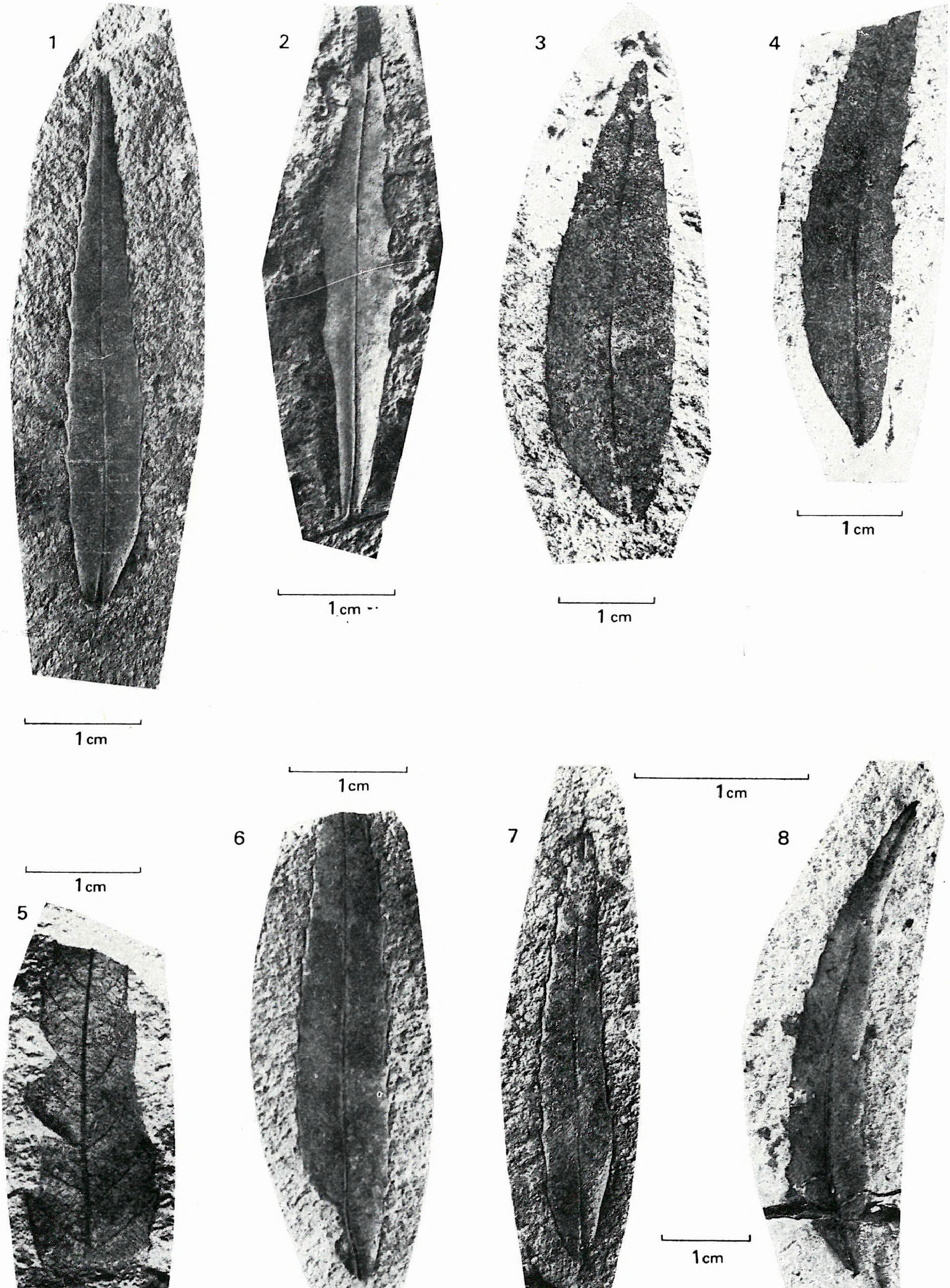
1. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 54. 1211.1.)
2. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 984.1.)
3. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 58. 544.1.)
4. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 54. 2006.1.)
5. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 906.1.)
6. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 987.1.)
7. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 889.1.)
8. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 878.1.)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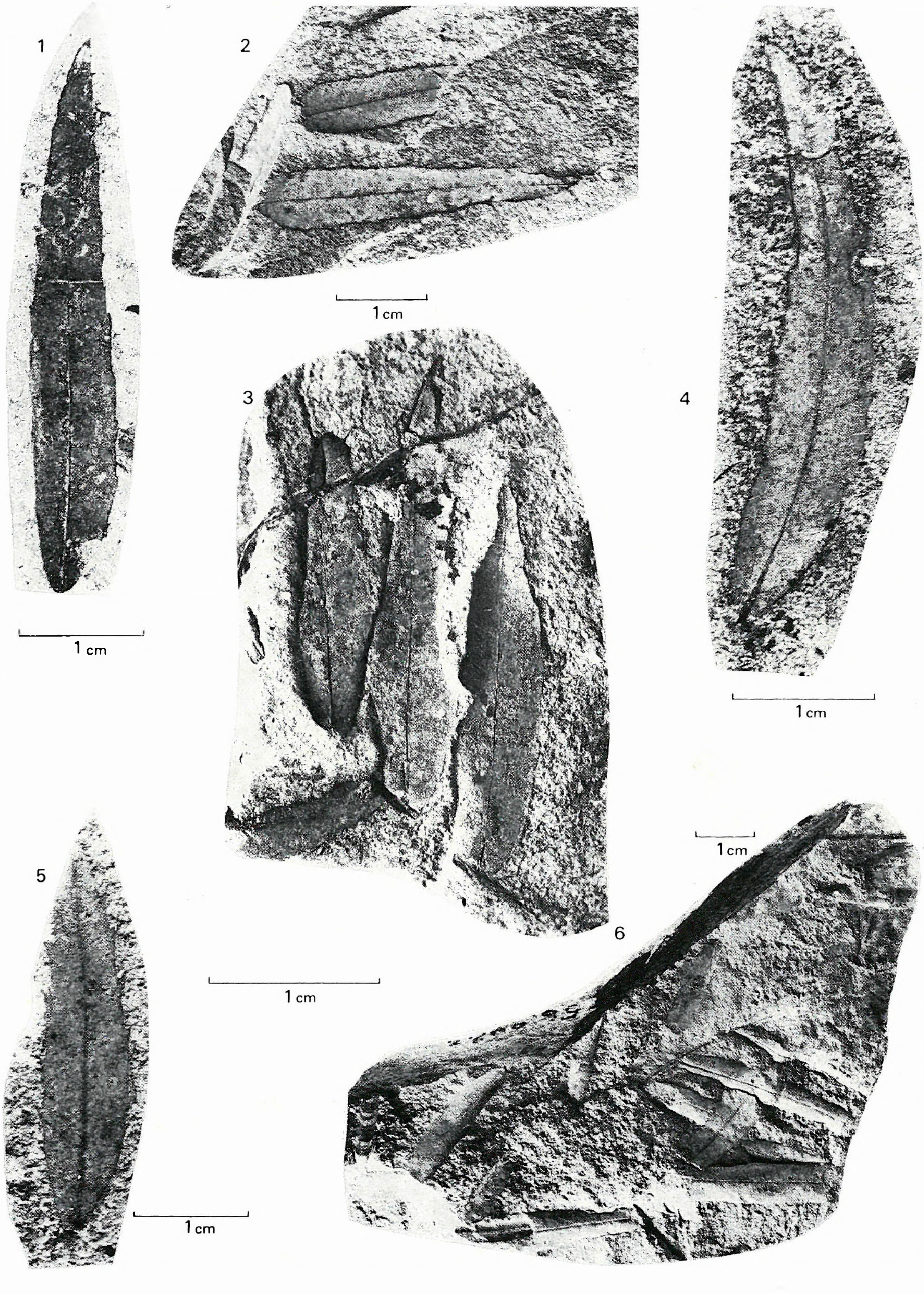
1. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 915.1.)
2. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 981.1.)
3. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 905.1.)
4. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 947.1.)
5. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 993.1.)
6. *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 56. 977.1.)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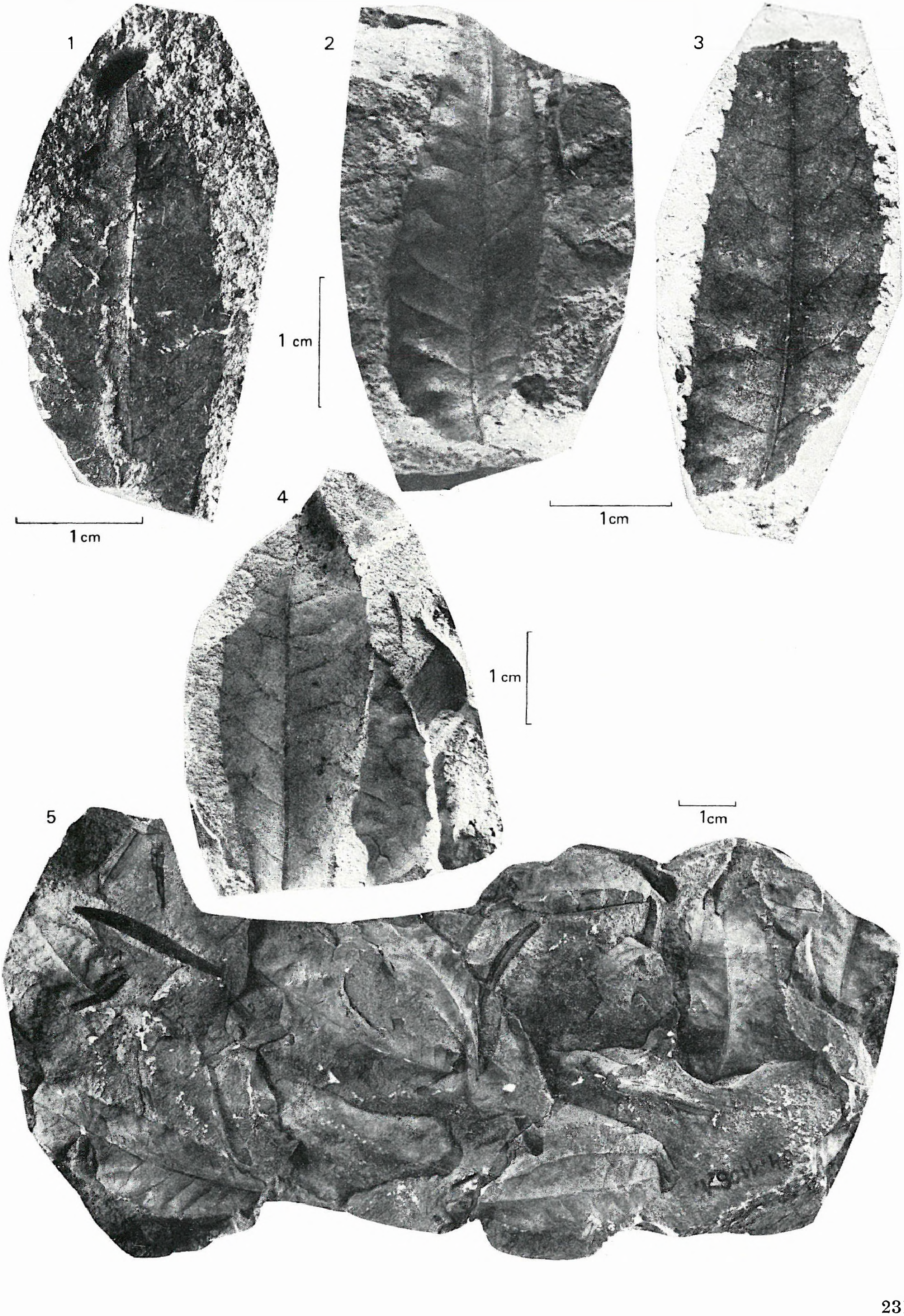
1. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1089.1.)
2. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1080.1.)
3. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1024.1.)
4. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1002.1.)
5. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch + *Engelhardtia orsbergensis* (Wessel et Weber) Jähnichen—Mai—Walter (TTM. 54. 1106.1.)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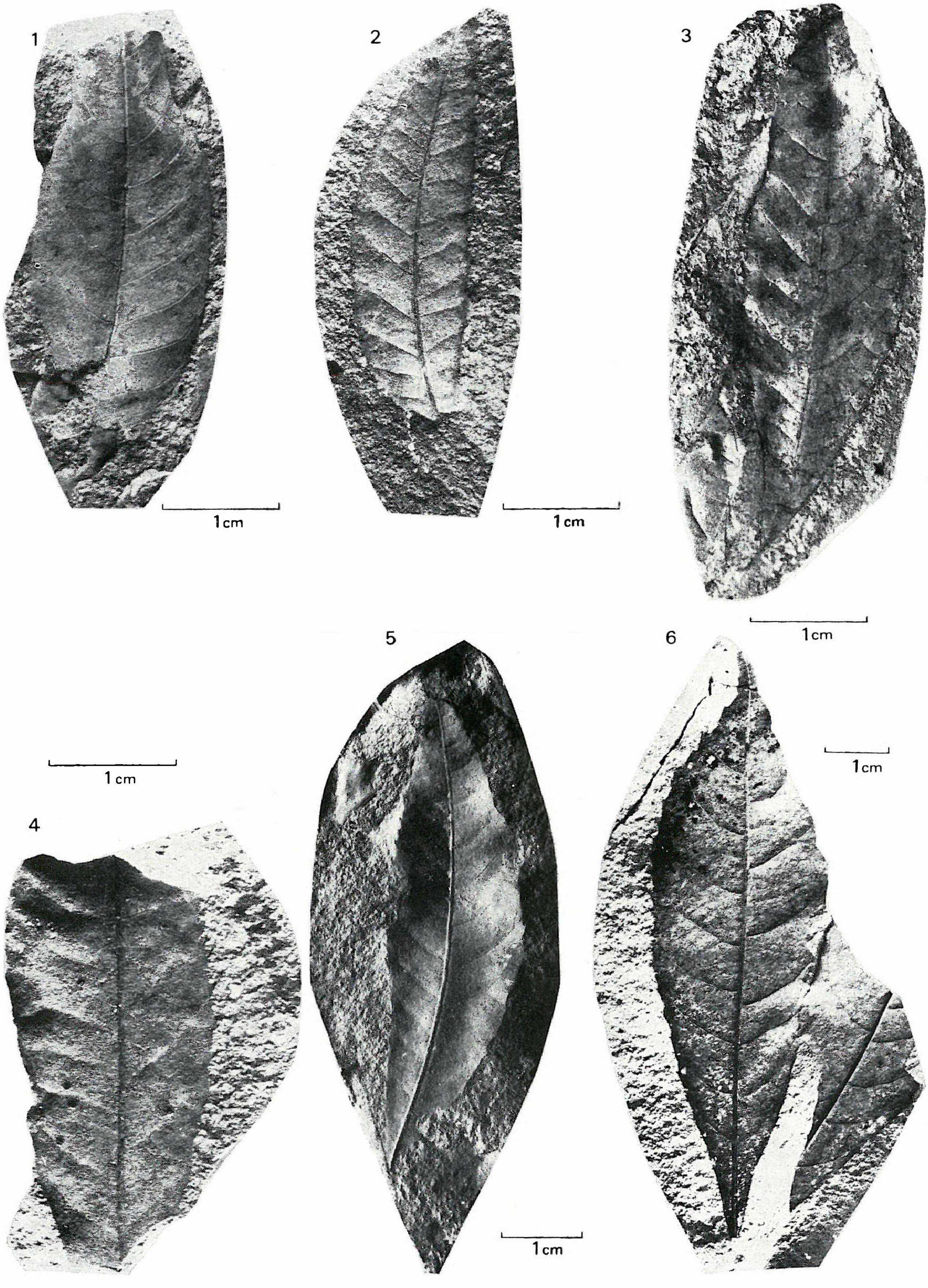
1. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1021.1.)
2. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1023.1.)
3. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1075.1.)
4. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1021.1.)
5. *Cyclocarya cyclocarpa* (Schlechtendal) Knobloch (TTM. 54. 1086.1.)
6. *Carya bartkoi* n. sp. (TTM. 82. 247.1.)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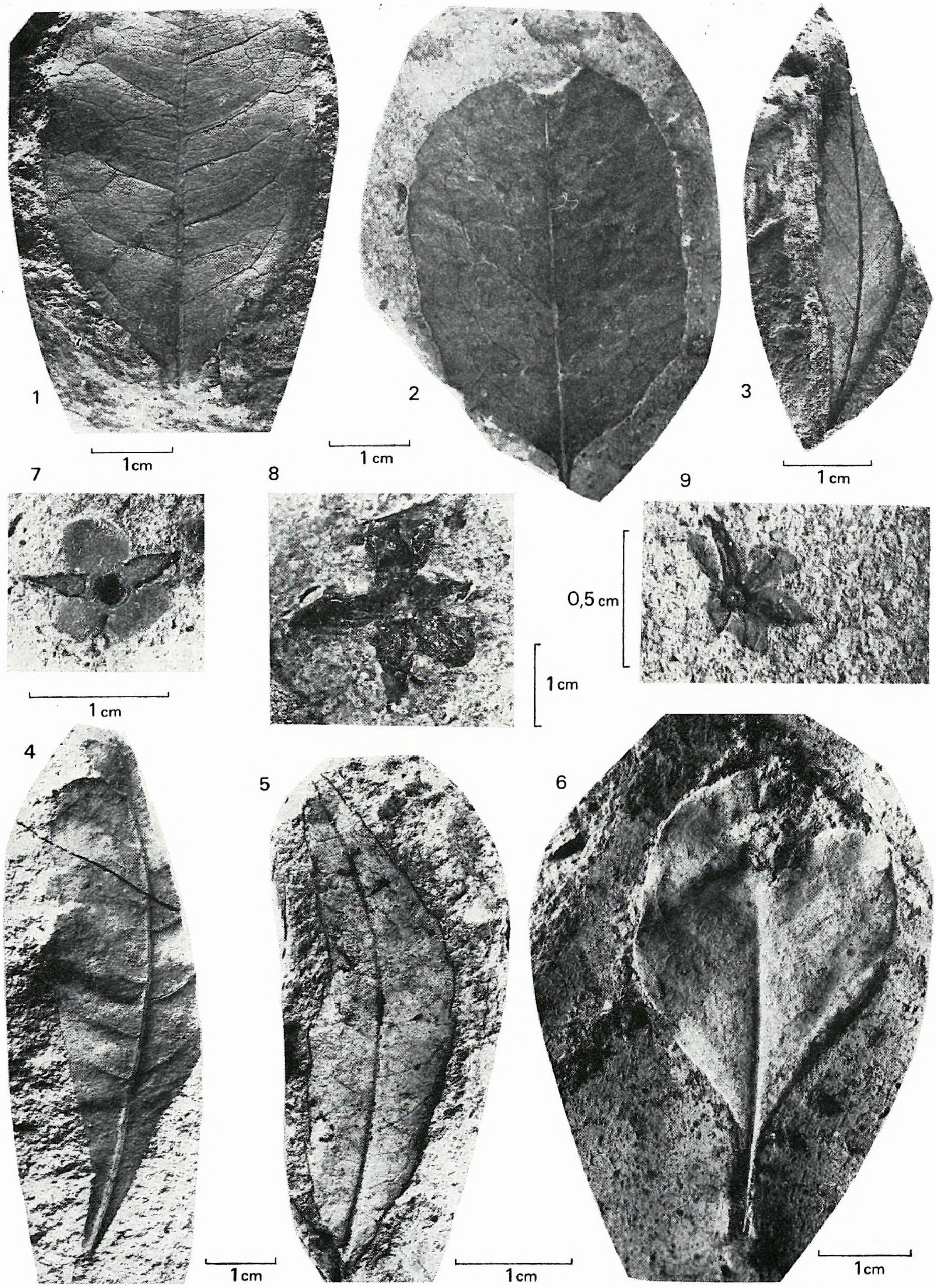
1. *Diospyros brachysepala* A. Braun (TTM. 82. 396.1.)
2. *Diospyros brachysepala* A. Braun (TTM. 82. 399.1.)
3. *Myrica hakeaefolia* (Unger) Saporta (TTM. 82. 243.1.)
4. *Carya bartkoi* n. sp. (TTM. 82. 247.1.)
5. *Myrica hakeaefolia* (Unger) Saporta (TTM. 82. 235.1.)
6. *Diospyros brachysepala* A. Braun (TTM. 82. 397.1.)
7. cf. *Diospyros rugosa* Saporta (TTM. 62. 804.1.)
8. cf. *Diospyros rugosa* Saporta (TTM. 62. 803.1.)
9. cf. *Diospyros rugosa* Saporta (MÁFI. 226.)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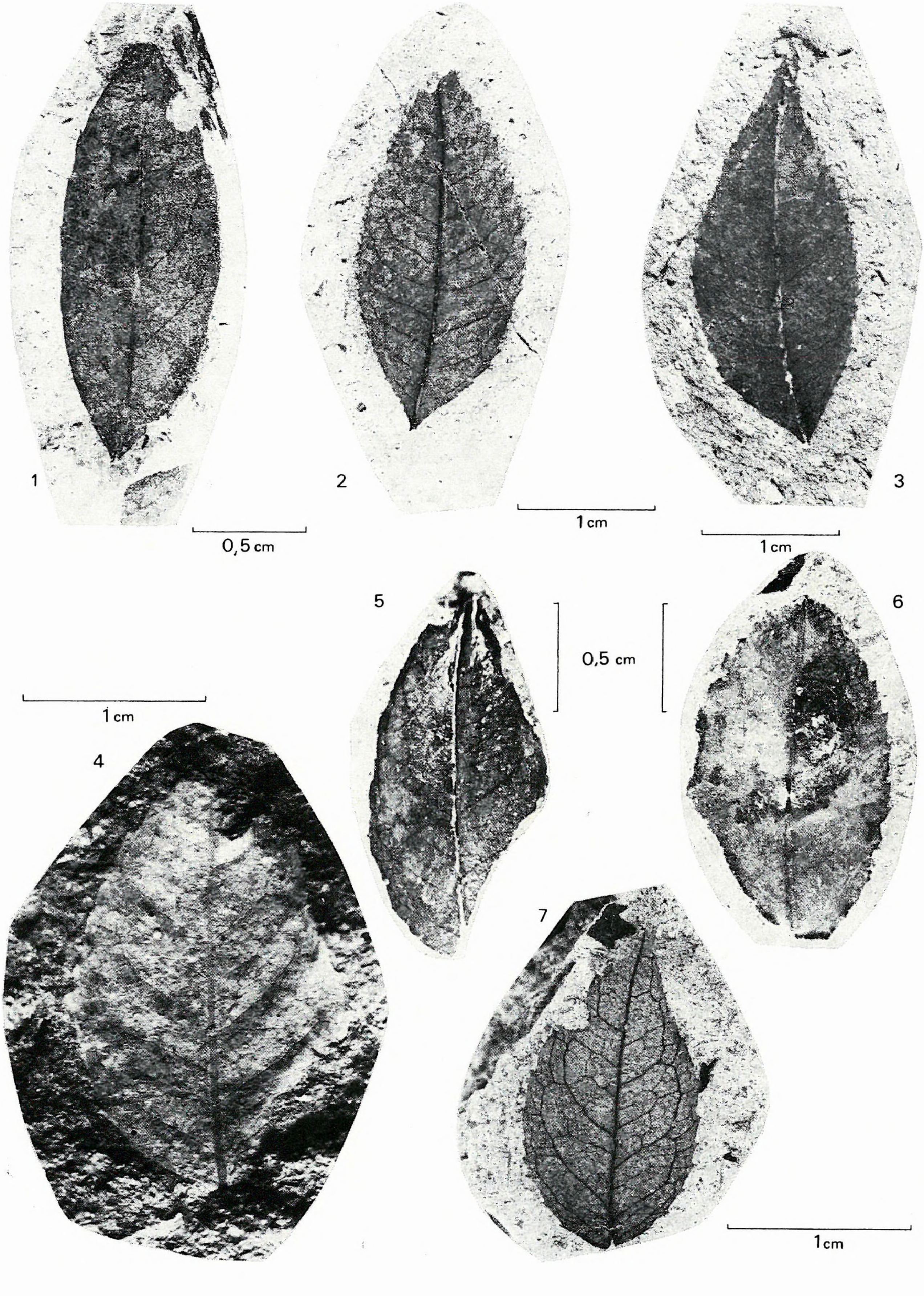
1. *Elaeocarpus palaeolanceolatus* KOLAKOVSZKIJ (TTM. 82. 418.1.)
2. *Spiraea* sp. 1. (TTM. 82. 220.1.)
3. *Spiraea* sp. 1. (TTM. 82. 221.1.)
4. *Spiraea* sp. 1. (TTM. 82. 229.1.)
5. *Spiraea* sp. 1. (TTM. 82. 231.1.)
6. *Spiraea* sp. 1. (TTM. 82. 232.1.)
7. *Spiraea* sp. 2. (TTM. 82. 236.1.)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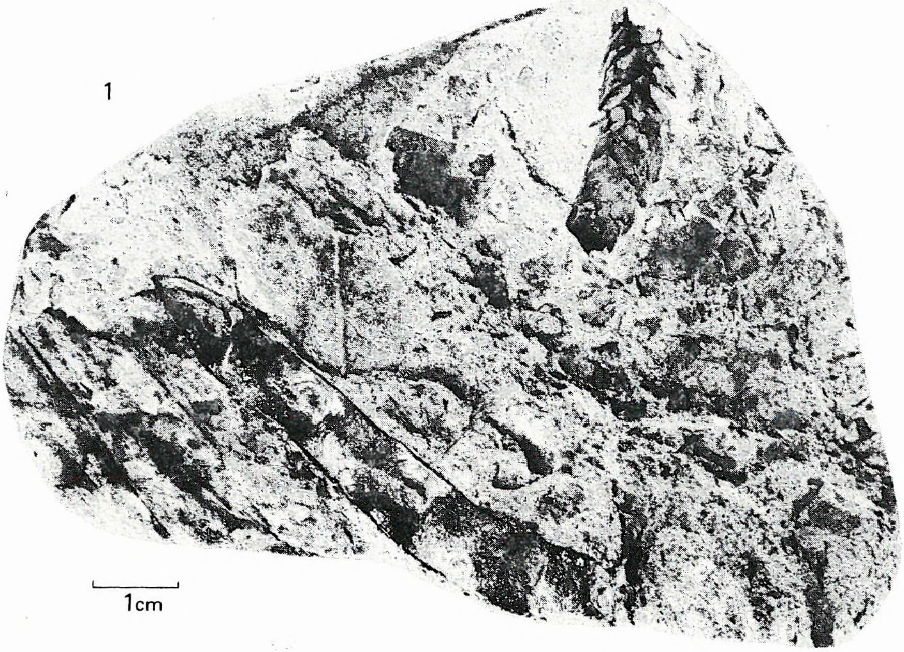
1. *Leguminocarpon pachyrhizoides* RÁSKY (MÁFI. 229.)
2. *Podogonium oehningense* (KOENIG) KIRCHHEIMER (TTM. 82. 219.1.)
3. *Schefflera gaudini* (SAPORTA) RÁSKY (TTM. 58. 11.2.)
4. *Podogonium oehningense* (KOENIG) KIRCHHEIMER (TTM. 82. 219.2.)

1



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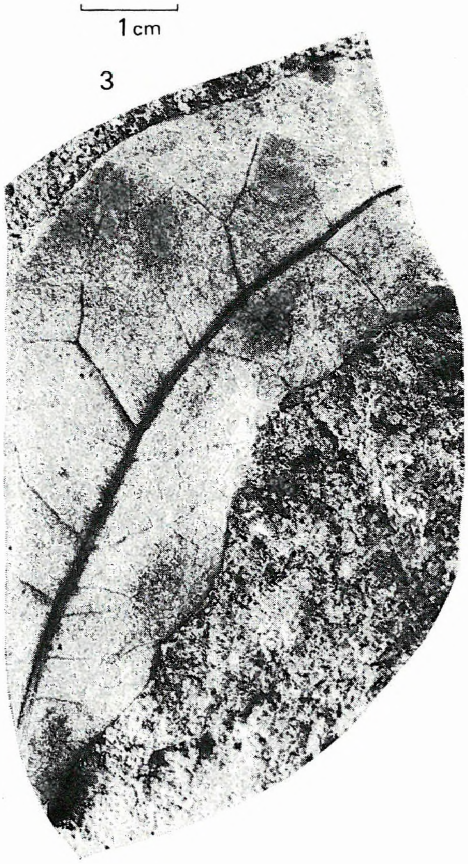
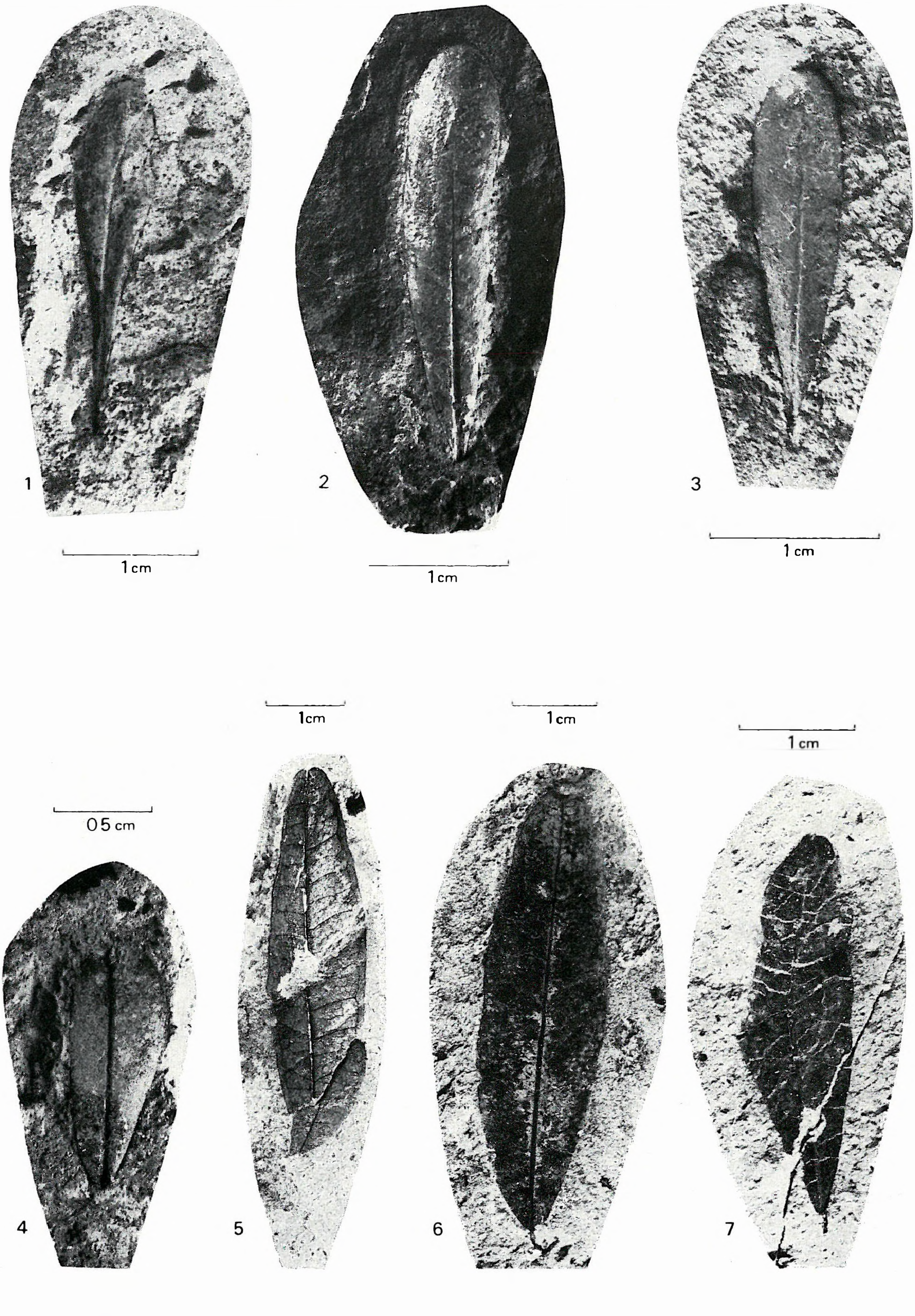


4

1. *Daphne oehningensis* (A. Braun) Weyland (TTM. 82. 238.1.)
2. *Daphne oehningensis* (A. Braun) Weyland (TTM. 82. 240.1.)
3. *Daphne oehningensis* (A. Braun) Weyland (TTM. 82. 239.1.)
4. *Daphne oehningensis* (A. Braun) Weyland (TTM. 82. 241.1.)
5. *Myrtophyllum* sp. (TTM. 82. 305.1.)
6. *Myrtophyllum* sp. (TTM. 82. 388.1.)
7. *Myrtophyllum* sp. (TTM. 82. 387.1.)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1. *Acer tricuspidatum* Bronn (TTM. 63. 932.1.)
2. *Acer tricuspidatum* Bronn (TTM. 63. 933.1.)
3. *Acer tricuspidatum* Bronn (TTM. 63. 934.1.)
4. *Oreopanax protomulticaulis* (Rásky) n. comb. (KFM. 56. 123.2.)

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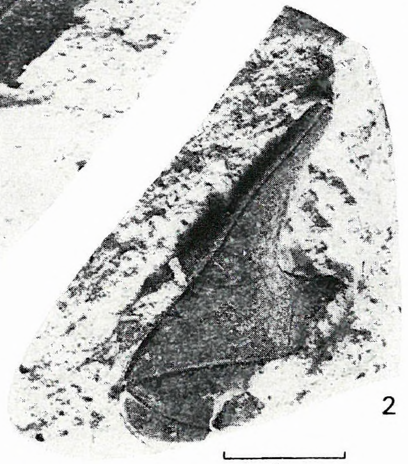
1 cm



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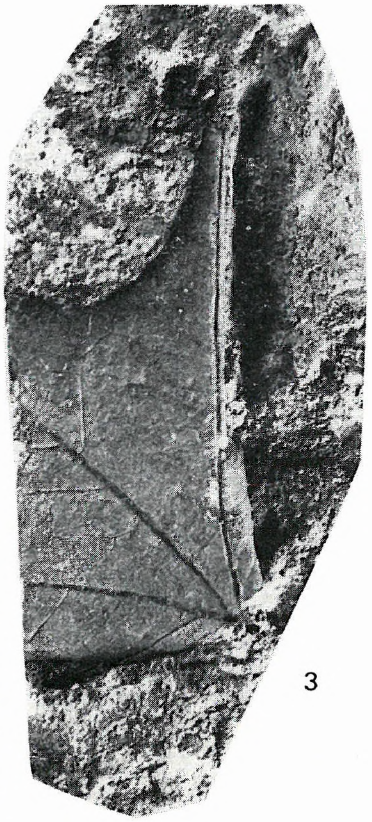

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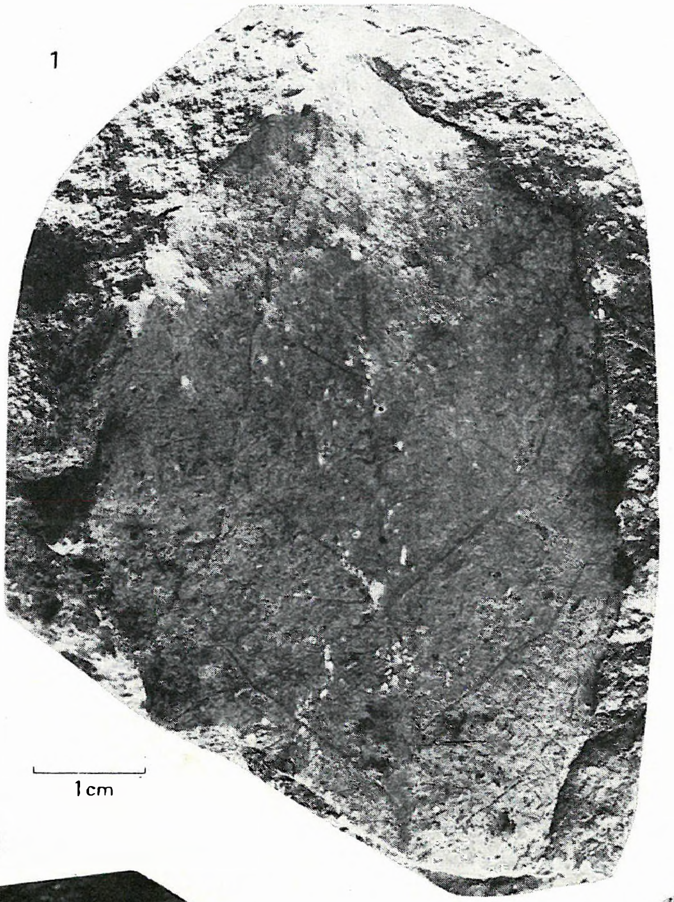
1. *Oreopanax protomulticaulis* (Rásky) n. comb. (TTM. 82. 421.1.)
2. *Oreopanax protomulticaulis* (Rásky) n. comb. (TTM. 82. 430.1.)
3. *Oreopanax protomulticaulis* (Rásky) n. comb. (KFM. 60. 96.1.)
4. aff. *Andromeda* sp. (MÁFI. 228.)

1



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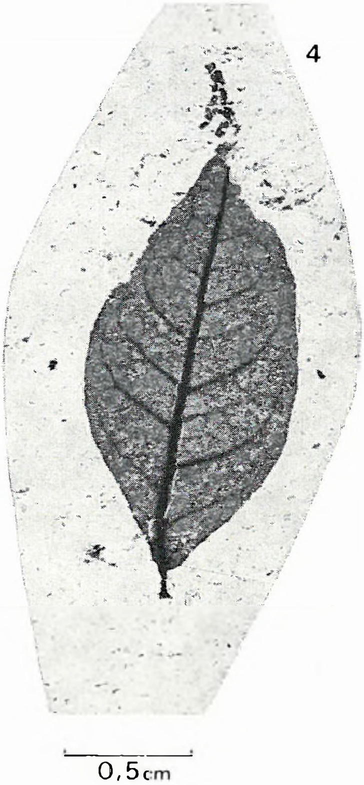

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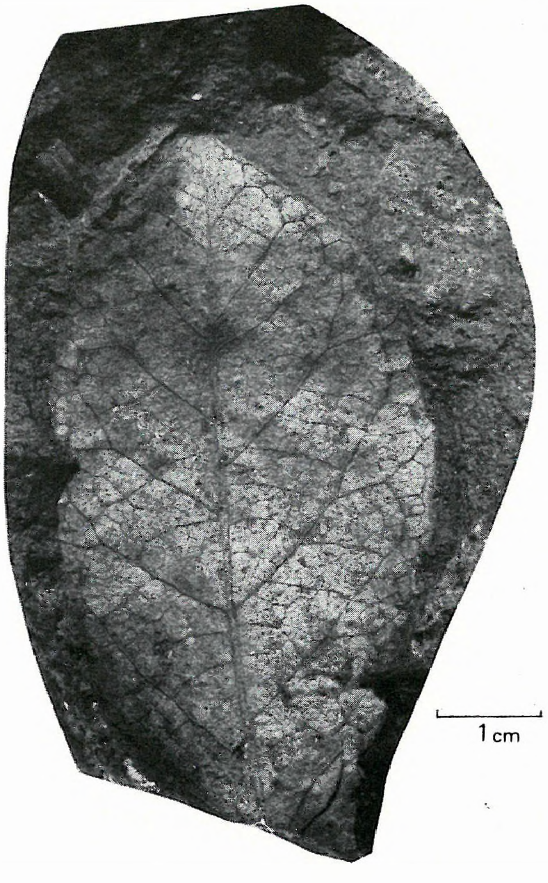
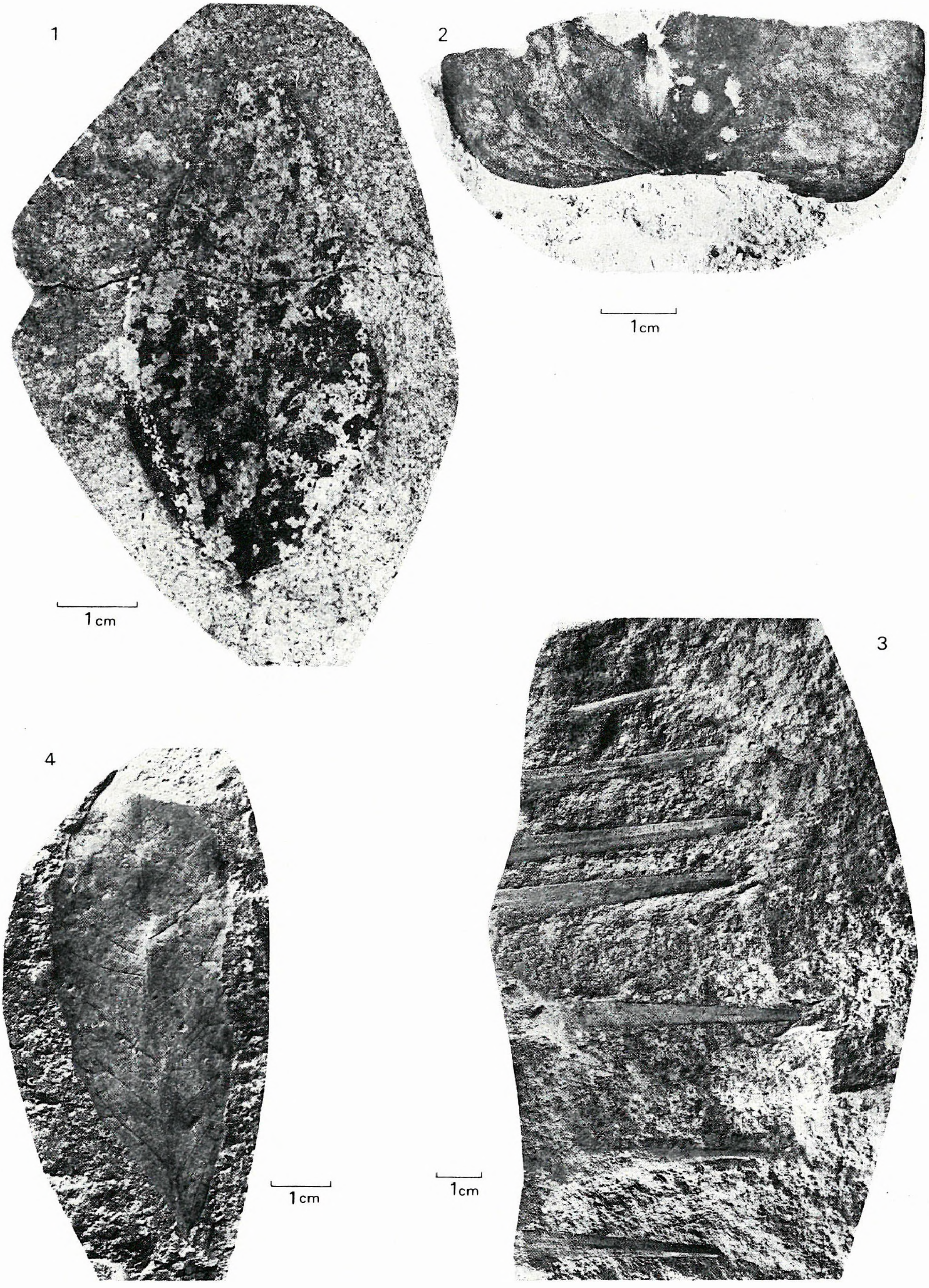


3

1. *Smilax weberi* WESSEL (TTM. 82. 218.1.)
2. *Smilax weberi* WESSEL (TTM. 82. 248.1.)
3. *Calamus noszkyi* JABLONSZKY (TTM. 58. 620.1.)
4. *Oreopanax protomulticaulis* (RÁSKY) n. comb. (TTM. 82. 420.1.)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1. *Smilax aspera* L. (fossilis) + *Carya bartkoi* n. comb. (KFM. 56. 94.1.)
2. *Smilax weberi* WESSEL (TTM. 82. 249.1.)
3. *Calamus noszkyi* JABLONSZKY (TTM. 56. 752.1.)
4. *Sabal major* (UNGER) HEER (TTM. 58. 680.1.)
5. *Calamus noszkyi* JABLONSZKY (TTM. 64. 413.1.)


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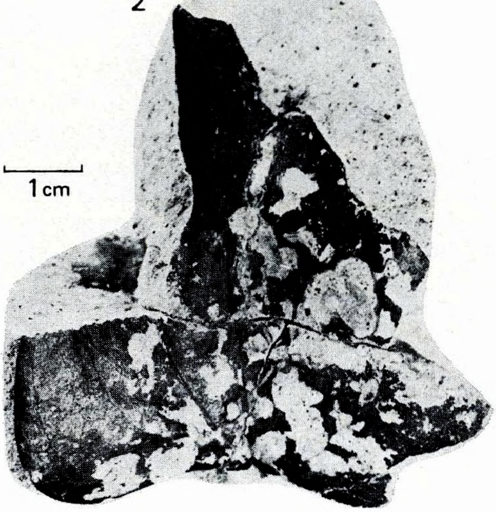

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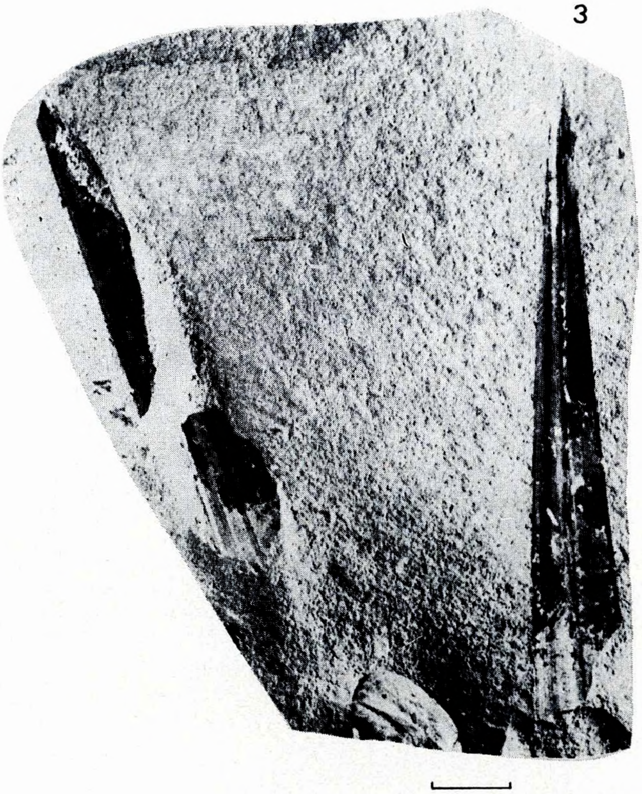

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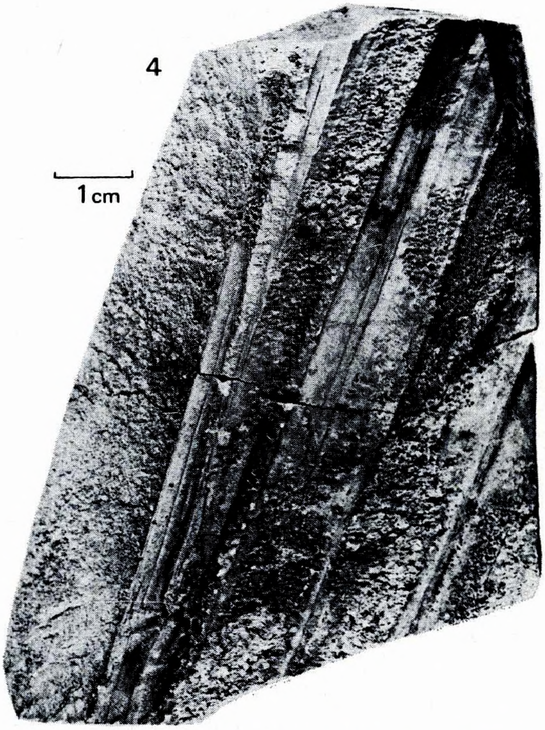

1 cm

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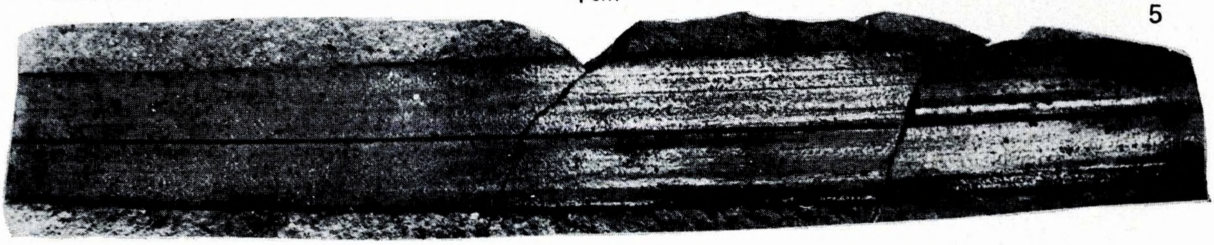

1. *Calamus noszkyi* JABLONSZKY (TTM. 58. 618.1.)
2. *Sabal major* (UNGER) HEER (TTM. 82. 484.1.)
3. *Sabal major* (UNGER) HEER (TTM. 58. 685.1.)

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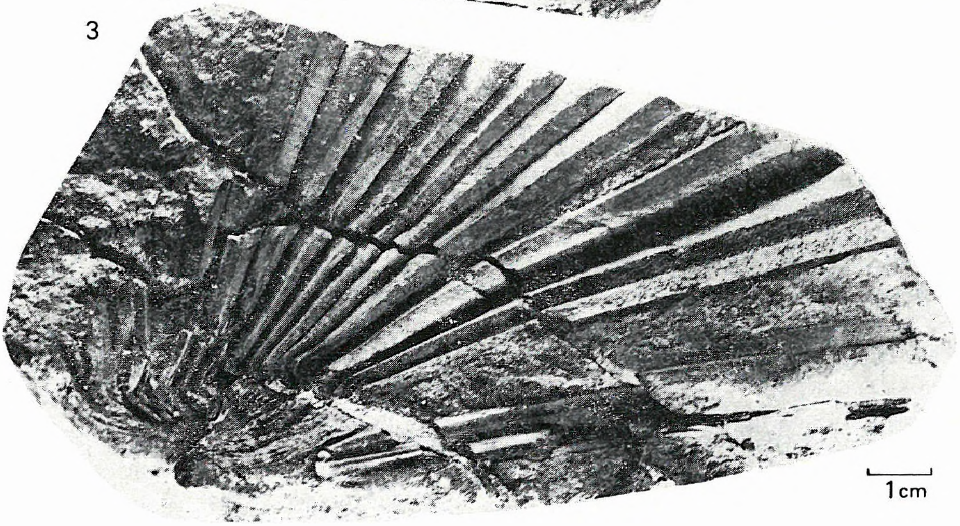
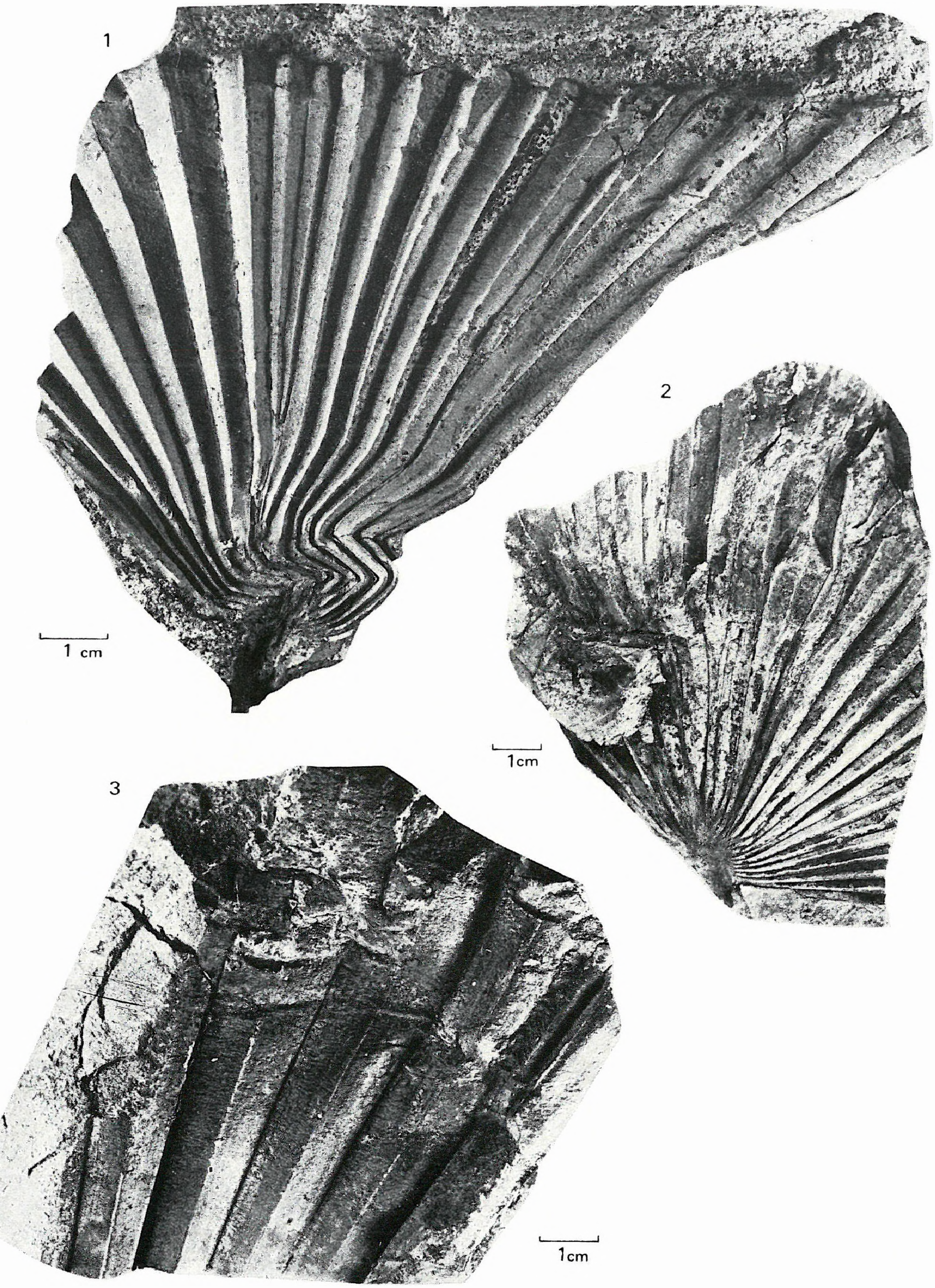


1. *Sabal major* (Unger) Heer (TTM. 58. 669.1.)
2. *Sabal major* (Unger) Heer (TTM. 58. 652.1.)
3. *Sabal major* (Unger) Heer (TTM. 58. 667.1.)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1. *Araceophyllum tarnocense* RÁSKY (TTM. 63. 852.1.)
2. *Araceophyllum tarnocense* RÁSKY (TTM. 63. 893.1.)
3. *Araceites hungaricus* RÁSKY (TTM. 63. 923.1.)
4. *Araceophyllum tarnocense* RÁSKY (TTM. 63. 851.1.)

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1 cm

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Fasciculus 46

Ragadozónyomok (Carnivoripeda nogradensis) a védőcsarnok alatt
Fotó: NÉMETH ERNŐ, 1983

Prints of Carnivoripeda nogradensis in the Conservation Hall of Ipolytarnóc
Photo: E. NÉMETH, 1983