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TERTIARY PLANTS FROM THREE NEW LOCALITIES IN SOUTHERN SLOVAKIA

In Slovakia (Czechoslovakia) there are a number of localities of tertiary plants, some having been known since the middle of the last century, chiefly due to DIONÝS ŠTÚR (1827—1894), the geologist and palaeontologist of Slovak origin.

Whilst Professor Dr. F. NĚMEJC of Prague has been almost the sole worker studying the tertiary flora of Slovakia during the past ten years, the palynological research, on the other hand, is now being carried out by several scientists, including Slovaks (Dr. BL. PACLTOVÁ, E. PLANDEROVÁ, P. SNOPKOVÁ, etc.). The majority of the hitherto known localities of tertiary plants are located in eastern, central, and southern Slovakia whilst the western part of Slovakia is very poor for records of fossil plants. The new localities published in this paper are situated in the western part of Southern Slovakia and represent comparatively very rich localities, which have been discovered by the workers of the Department of Geology and Palaeontology of the National Museum in Prague.

There are three localities situated in close proximity, i. e. Bory, Domadice, and Brhlovce in the Levice district. The impressions of leaves and wood belonging to the neogeneous flora were found in volcanic andesitic tuffites*) and tuff, often in very irregularly formed deposits with, for instance, the fossiliferous layer at the richest locality, Bory, rather thin (from 1 cm to 1 dm).

The largest quantity and the most valuable material were obtained at Bory, which has been worked continually during short visits of one to three days since 1955 (with the exception of 1957). However, there was very little material available from the other two localities as the site near Domadice has only been visited twice, and the Brhlovce locality once. It may nevertheless be expected that, in the future, the Horní Brhlovce locality in particular will provide very fine collections if properly explored. All the material obtained has been

*) Tuffite — volcanic ash subjected to inundation by flood water or deposited in lakes and seas and hence suitable for the preservation of fine impressions.

deposited at the Department of Geology and Palaeontology of the National Museum in Prague under the numbers 36308-10, 36566, 37018, 110/59, 1045/60, 1048/61, 990/61, 991/61, 993/61, and 994/61.

B o r y

At the Bory locality, which lies about 11 km southeast of Levice, the impressions of the neogeneous flora are preserved mainly in finely grained (rarely also in the more coarsely grained) andesitic tuffites and tuff.

The original and richest locality from which the fossil flora from Bory is known contains old tunnels (which are no longer used) leading into low sloping ground northwest of the village (the left-side slope of the valley of a rivulet which joins the Bur brook at Bory). This locality for the extinct tertiary flora at Bory was originally discovered, whilst a student, by LACO ČEREJ of Bory, though the local inhabitants have probably been long acquainted with the leaf impressions in the tunnels. As L. ČEREJ had worked for some time previously at the Museum of National History at Levice, he donated to the Museum several pieces of tuffite with impressions of leaves, where, in 1955, they attracted the attention of Dr. VLASTISLAV ZÁZVORKA, director of the Department of Geology and Palaeontology of the National Museum in Prague, who, with A. ŽERTOVÁ*) and M. DOKTOROVÁ, chanced to be on a collecting tour in southern Slovakia. They assumed that the impressions of the fossil flora must have come from the neighbourhood of Levice and, by a coincidence, met L. ČEREJ near Bory, who took them to the site where he had found his fossils.

A quantity of very valuable material was obtained from this locality during 1955 (VL. ZÁZVORKA, A. ŽERTOVÁ and M. DOKTOROVÁ), 1956 (A. ŽERTOVÁ and M. DOKTOROVÁ), 1958 (F. KOTLABA, VL. ZÁZVORKA and M. DOKTOROVÁ) and particularly 1959—61 (F. KOTLABA and V. BARTOŠ). The fossiliferous layer forms the roof o f t h e t u n n e l s, which, whilst permitting a considerable surface area to be exposed, produces difficult working conditions as, to obtain the impressions, it is necessary to work with the hands above the head in a rather poor light. There was also the danger of pieces of rock falling from the roof, as whole slabs of tuffite had become loose in some places. The loosened pieces of tuffite containing the impressions had to be freed very carefully so as to prevent their falling to the ground and, because of the brittleness of the tuffite, many fine impressions were frequently damaged or completely destroyed. Tuffite, though mostly distinctly stratified, c r a c k s v e r y e a s i l y, often not along the strata but, unexpectedly, diagonally or even at right angles to the strata. The removal of the impression from the larger pieces was carried out, when possible, on the sloping ground in front of the tunnels, where there was plenty of light and room but sometimes there was such a dense accumulation of impressions as to make it practically impossible to obtain a well preserved impression of the leaves.

A small part of the material was studied by A. ŽERTOVÁ, whilst I have dealt with the remainder. However, a lot of material still remains undetermined, partly resulting from the fragmentary character of the collections and partly because of my insufficient experience. A more experienced phytopalaeontologist should be able to determine a whole number of further interesting species from this locality, or to improve on my present determinations.

In the years 1960—61, together with V. BARTOŠ, conservator of the Department of Geology and Palaeontology of the National Museum in Prague, the wider neighbourhood of Bory was also examined, and we succeeded in finding a fossil flora in other localities, particularly in the densely overgrown ravines north of the village, which run down to the Bur brook from both sides of the valley. We also examined most of the tunnels (some of which are still used) at the eastern limits of Bory, but with negative results.

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No species of the lower plants were found with not a single representative of the ferns, and only one species of the *Gymnospermae.* Most of the collections comprised *Angiospermae,* almost exclusively trees and shrubs.

Taxodiaceae

Glyptostrobus europaeus (BRONGN.) HEER — Tab. III, fig. 1

A rather frequent species, of which a total of seven specimens have been found, in two cases with cones. This is a typical miocene element known from the Tertiary sediments of almost the whole of the northern hemisphere. The fossil *Glyptostrobus europaeus* is very closely related to current *Glyptostrobus pensilis* (STAUT.) K. KOCH (= *heterophyllus* ENDL.). the only species of *Glyptostrobus* growing today, which is indigenous to southeast China and forms a low tree (KLIKA, ŠIMAN, NOVÁK and KAVKA 1953). It has a distinctly antique character — truly a "living fossil" — as even in its native country it is known only from cultivation and does not grow wild.

Cercidiphyllaceae

Cercidiphyllum crenatum (UNG.) BROWN — Tab. III., fig. 2

In older works, this species, with its characteristic shape and nervation, is known mainly as *Grewia crenata* (UNG.) HEER. The fossil *Cercidiphyllum crenatum* differs only very slightly from the recent *Cercidiphyllum japonicum* S. et. Z., which is a tree from 10 to 30 m tall, frequently branching at the base, indigenous only to Japan (PILÁT 1953). Today it is the only representative of the monotypical genus and family, which fact, besides the morphological and anatomical characters, clearly indicates its considerable antiquity. We found three impressions of the fossil *Cercidiphyllum crenatum,* with one comprising a very good positive and negative.

Hamamelidaceae

cf. *Liquidambar europaea* A. BROWN

A few impressions with obscured edges, so that it was not possible to make a definite determination, but the whole character of the leaves and their secondary nervation indicate this species, which is generally known from the younger Tertiary. With regard to the recent species, the fossil *Liquidambar europaea* is most closely related to the North-American *Liquidambar styraciflua* L., a large tree up to 45 m tall, with 6—18 cm broad leaves. *Liquidambar orientalis* MILL. (= *L. imberbis* AITON) from Asia Minor, a tree reaching a height of up to 20 m, with small leaves from 4 to 5 cm broad (PILÁT 1953), is a more distant relative.

Parrotia pristina (ETTINGSH.) ŠTÚR — Tab. III., fig. 3, 4

A conspicuous species, readily recognised from the shape and nervation of its leaves, was found on five occasions. Very similar leaves are possessed

by the current *Parrotia persica* C. A. MEYER of Asia, which is a shrub or low tree up to 5 m tall, and the North-American *Fothergilla alnifolia* L. (= *F. gardenii* MURR.), a low shrub reaching a height of up to 1,5 m. *Parrotia* differs from the genus *Fothergilla* chiefly by its flowers, i. e. the number of stamens, shape of anthers etc.: *Parrotia* has 5—7 drooping stamens and linearly oblong anthers, whereas *Fothergilla* has 24 erect stamens with ovate anthers (PILÁT 1953). I have examined herbarium material comprising leaves of recent species of both genera and have had great difficulty in distinguishing between them. Nevertheless, I refer the fossil species, similar to ŠTÚR (1867), to the genus *Parrotia,* as the only recent species of this genus has somewhat tougher leaves than *Fothergilla,* hence the preservation of the impressions in the rather coarse tuffite.

Parrotia pristina is often mentioned in the literature under the name *Parrotia fagifolia* (GOEPP.) HEER, which I do not consider correct from the nomenclatural point of view, as the specific name *"pristinum"* is older and therefore enjoys priority. The species was described first by ETTINGSHAUSEN (1851) as *Styrax pristinum.* However, ETTINGSHAUSEN only had at his disposal the lower half of a leaf, and he assumed the complete leaf to be entire; he therefore compared it with the recent species *Styrax officinale* L., though it is not even related, and has leaves of a different shape. However, D. ŠTÚR (1867) defined the generic relationship of this fossil with absolute accuracy and transferred ETTINGSHAUSEN's species to the genus *Parrotia.* He worked out a detailed synonymy and produced a fine illustration of two whole leaves. Simultaneously he pointed out a number of distinctive characters of this species: the prominence of the base of the two lowest secondary nerves almost outside the leaf blade, the entireness of the leaves in their lower halves, and the undulate-dentate leaves with short, prominent teeth in the upper half, divergent two lowest secondary nerves compared with the other secondary nerves (the two lowest secondary nerves are opposite and emerge at a sharper angle, 30—35°, whereas the other secondary nerves are usually alternate and emerge from the midrib at a blunt angle, 40—60°), and, further, the fact that the leaves are somewhat asymetrical with the half of the leaf where the first non-binary secondary nerve develops being larger. From this uncommonly thorough analysis it is possible to form quite reliable conclusions; if anybody should doubt that ETTINGSHAUSEN really dealt with this species (with regard to the illustration of the leaf fragment), then ŠTÚR's illustration and description absolutely leave no doubt at all, as he complemented ETTINGSHAUSEN's description and correctly emended his species.

The second, and therefore incorrect, name for our species is *Ficus pannonica* ETTINGSHAUSEN (1853), which, in my opinion does not apply to this species, but is often cited as a synonym in the literature. The third, as regards time, is *Quercus fagifolia* GOEPPERT (1855), transferred to the genus *Parrotia* by HEER (1869), who had previously (1859) pointed out the relationship of GOEPPERT's species with this genus. However, as regards the priority of ETTINGSHAUSEN's species, this transfer is not justified nomenclaturally. The species of ETTINGSHAUSEN and GOEPPERT are identical and approximately of the same age (Miocene), so that the application of the name *Parrotia fagifolia* is incorrect.

Perhaps it is also worth mentioning that, although it was ETTINGSHAUSEN who first validly described this species, he had n o i d e a as to its generic (and also specific) relationship. At first he described the fossil (1851) as *Styrax pristinum* and later (1853) as *Ficus pannonica* (unaware that they were identical); still later (1867) he even considered *Ficus pannonica* a synonym of *Populus mutabilis* HEER! However, these facts are insignificant from the nomenclatural point of view and have no influence on the priority of ETTINGSHAUSEN'S name *"pristinum"*. With regard to Š t ú r' s description of *Parrotia pristina,* I should like to point out that the species under discussion has m o r e s h a r p l y p o i n t e d l e a v e s.

Fagaceae

Castanea aff. *dentata* BORKH. — Tab. IV, fig. 1

We found a total of about five collections of leaves of this chestnut, one comprising a very fine impression and counterimpression, as if painted in white, in very fine, grey-brown tuffite. Also, with its very detailed tertiary nervation, the fossil species is almost indistinguishable from leaves of the North-American *Castanea dentata* BORKH., which is a tree up to 30 m tall and grows in the eastern United States (PILÁT 1953). In addition, the shape and the size of the marginal teeth of the leaves are remarkably identical. The leaves of *Castanea dentata* differ from the other species mostly by their w e d g e l i k e b a s e. However, as I had at my disposal only the upper parts of leaves, I was unable to make a definite identification. *Castanea latissima* ANDR. of the fossil *Castaneae* comes considerably close to the fossil species but does not have such pointed leaves and the secondary nerves rise at a more rounded angle. It is, of course, not impossible that ANDREÁNSZKY's new species is not a good species, as the characters mentioned may be variable.

It is more than likely that at least a part of the collections mentioned in the literature under the name *Castanea atavia* UNG. or *C. kubinyi* KOV. belong to *C. dentata.* However, CZECZOTTOWA (1953) places them in the genus *Quercus* and compares them with *Quercus libani* OLIV., so they were obviously not chestnuts, but, nevertheless, they are often confused in the literature. At the moment the correct nomenclature of this fossil species is not clear to me and requires further study.

Quercus spec.

In our material from Bory there are fragments of different leaves which obviously belong to oaks, probably to several species. However, the incompleteness of the material and the author's insufficient phytopalaeontological experience have precluded their identification, though it is possible that they may include some new species. One collection (positive and negative) considerably resembles *Quercus sályensis* ANDR., described from the Hungarian Sarmatian. However, because of the incompleteness of the material (I had at my disposal only the lower half of a leaf) and the doubtful value of some of ANDREÁNSZKY's new species, it was impossible to arrive at a definite conclusion.

Juglandaceae

Juglans aff. *regia* L. — Tab. IV, fig. 3

There were only three impressions, of which one in particular resembles the recent *Juglans regia* L., a tree indigenous to southern Europe. Whilst fossil

species are usually represented only by impressions of single leaflets of a compound (pinnate) leaf and not of a whole leaf, the characteristic secondary and tertiary nervation always allows a determination to be made.

Pterocarya denticulata (O. WEBER) HEER — Tab. IV, fig. 6 on the left

There were the impression and counterimpression of only one leaflet of a compound leaf, but well conforming with descriptions and illustrations in the literature. The very closely related species, *Pterocarya castaneifolia* (GOEPP.) SCHLECHT., described three years later (1855), differs primarily by its fruits. The leaves of both species are practically indistinguishable (teste ANDREÁNSZKY 1959), and therefore we place our fossil under the older species, which is better known in the literature. Of the species growing today, the fossil *Pterocarya denticulata* is most closely related to *Pterocarya pterocarpa* (MICHX.) KUNTH [= *P. fraxinifolia* (LAM.) SPACH = *P. caucasica* C. A. MEYER]. It is large tree up to 30 m tall, indigenous to western Asia from the Caucasus to northern Persia (PILÁT 1953).

Salicaceae

Salix cf. *media* HEER — Tab. III, fig. 5

There is only one impression (positive and negative) of an incomplete leaf but quite well conforming with HEER's (1856) description. However, in view of the fragmentary character of the material it is not possible to make a more definite determination.

Populus latior A. BRAUN — Tab. III. fig. 6

I obtained a total of three impressions, of which one (a half leaf) is very good, with a clearly discernible nervation and a well preserved leaf margin. It conforms well with the descriptions and illustrations in the literature but is of rather small size. This poplar used to be an important component of the Miocene flora in almost the whole of Europe. According to the literature of the recent poplars, the following rather closely resemble the fossil *Populus latior: Populus canadensis* MOENCH (with which the fossil species can hardly be compared, as it is a cultivated hybrid) and *Populus monilifera* AIT. (*P. deltoides* MARSH.), which is a North-American tree, have very similar leaves.

Ulmaceae

Ulmus braunii HEER — Tab. IV, fig. 4, 5

This is one of the most frequently found fossils, and about twenty collections have been made, usually as well preserved specimens. My concept of this species conforms substantially with HEER's (1956) and also NĚMEJC's (1949) views, though the fossil elms are usually treated somewhat differently. Amongst the recent elms (in the older concept) the elm most closely related to the fossil *Ulmus braunii* is, in my opinion, *Ulmus carpinifolia* GLED. (= *U. glabra* MILL. non HUDS., *U. campestris* L. em. HUDS.), and, more distantly, *Ulmus montana* STOKES (= *U. glabra* HUDS. non MILL., *U. campestris* L. p. p.).

These two recent elms differ chiefly in their fruits, and only insignificantly in their leaves, which differences cannot be used very well for a comparison with the fossil species. HEER (1859) compares *Ulmus braunii* with *U. laevis* PALL. (= *U. effusa* Willd.), which, however, differs considerably both as regards the sharp serration of the leaves and the very short, forked, secondary nerves in the upper half of the leaf (the main distinctive characters, however, are the shape and the hairiness of the fruits, which characters cannot be used in this instance). *Ulmus japonica* SARG. of the foreign elms is rather similar to *U. braunii,* but has a distinctive asymmetrical base to the leaves, and a sharply acuminate, somewhat elongated apex, which is not found in the fossil species. Also, *Ulmus hollandica* MILL., grown commonly in parks and gardens, considerably resembles our fossil species, but, as it is a cultivated hybrid of *U. carpinifolia* and *U. montana,* it cannot be compared with the fossil species.

Ulmus minuta GOEPP. — Tab. IV, fig. 2

There is a single but very well preserved specimen, impression and counter-impression, which well conforms with the description and illustration in the literature. It is a species with small, 1.5—4.5 cm long and 1—3 cm broad leaves, whose single, somewhat crenate margin is the most distinctive character (this is t h e o n l y elm with a single toothed leaf margin). The number of secondary nerves is rather small, 5—10. *Ulmus parvifolia* JACQ. (= *U. chinensis* PERS. = *Planera chinensis* SWEET) of the recent species resembles very closely the fossil *Ulmus minuta* in all these characters. *Ulmus parvifolia* JACQ. is a tree 15—25 m tall growing in Korea, northern and central China, and Japan (PILÁT 1953). Its leaves surprisingly resemble the fossil *Ulmus minuta,* as I convinced myself by comparing herbarium material. The difference sometimes mentioned, i. e. the narrower base of the leaf, is not a constant character, as leaves with a rounded base occur quite commonly in the recent species. I therefore feel justified in assuming that this is not a small (or young) leaf of a different elm, as the single or manifold serration of the leaf margin is a b a s i c t a x o n o m i c c h a r a k t e r, which is constant and cannot fluctuate according to the size or age of the leaf. REIMANN (1919) cites *Ulmus minuta* as a synonym for *U. carpinoides* GOEPP., but this is incorrect. In his concept, *U. carpinoides* is pronouncedly heterogeneous and includes several species, at least two. According to HEER (1856), *Ulmus parvifolia* A. BRAUN (1845) is identical in part with *U. minuta* GOEPP. (1855), but BRAUN's species is sometimes erroneously referred to *Zelkova.* However, BRAUN's name, *Ulmus parvifolia* (which would have priority over *U. minuta* GOEPP.) cannot be used as JACQUIN (1798) had previously described the above mentioned recent species under the same name. *Ulmus parvifolia* JACQ. 1798 thus clearly antedates the fossil *U. parvifolia* A. BRAUN 1845.

Zelkova zelkovaefolia (UNG.) BŮŽEK et KOTLABA comb. nov. — Tab. III., fig. 7, 8

Basonym: *Ulmus zelkovaefolia* UNGER, Chloris protogaea p. 94—95, 1847; Tab. 24, fig. 9—12, tab. 26, fig. 7 (exclusis fructibus tab. 24, fig. 7 et 8, tab. 26, fig. 8, et folium tab. 24, fig. 13!), 1843.

Synonyms: *Planera ungeri* ETTINGSH. 1851, *Zelkova ungeri* (ETTINGSH.) KOVATS 1856.

There are three collections of this species, including one fine impression and counterimpression, and one impression of a fruit (which is a very rare find for this species).

The species has hitherto been mentioned in the literature only under the name *Planera ungeri* ETTINGSH. or *Zelkova ungeri* KOVATS. Its nomenclature is rather obscure and hitherto no correct name has been used. The oldest name of our species is *Ulmus zelkovaefolia* UNG. 1843. As both Č. BŮŽEK and I have arrived at this identical conclusion quite independently, we formally publish the new combination.

UNGER in his work "Chloris protogaea" (the atlas of illustrations with names was published in 1843, from which time the new taxa must be dated, and the text was published in 1847) illustrated and described the species under the name *Ulmus zelkovaefolia,* as can also be seen from the synonyms in ETTINGSHAUSEN (1851), HEER (1856), KOVATS (1856) etc.

However, UNGER made two mistakes: in tab. 24, fig. 13 of the cited work he illustrated the leaf of some quite different kind of plant (which he probably realized, as, in his notes to the plate, he writes: "Fig. 13. Eine von den übrigen mehr abweichende Form...") and — which is the main point — he quite erroneously attributed the fruits of the elm (achenes with membranous wings) to the leaves of a species whose fruit is a drupe, although he had not found them directly connected with each other. Not even the illustrations in plate 24, fig. 7, showing a single piece of rock with the impressions of a fruit of *Ulmus* together with leaves of *Zelkova* belong to each other. In his notes to the plate, UNGER writes about this illustration: "Tab. 24, f. 7: Blätter und Flügelfrucht von *Ulmus zelkovaefolia.* Letztere ist an dem Exemplare nicht vorhanden, wurde aber wegen Raumersparung dahin gesetzt". Here UNGER was well aware how doubtful it was to connect the fruits of an elm with the leaves that he had illustrated under the name *Ulmus zelkovaefolia,* as in the above-cited work he writes: "Dass die Früchte der Gattung *Ulmus* gehören, ist kein Zweifel unterworfen, dass aber auch die Blätter den Haupttypus von *Ulmaceen* besitzen, ist eben so wenig zu läugnen, nur frägt es sich, ob nicht andere gleichfalls zu dieser Familie gehörigen Blattreste aus derselben Localität eher mit obigen Früchten in Verbindung gebracht werden können".

Unger became even more doubtful when he compared his *Ulmus zelkovaefolia* with recent species of plants, and finally reached the conclusion that his „elm" did not resemble any recent species of the genus *Ulmus,* but belonged to a quite different genus, *Zelkova.* Of this he writes: „Unter den verwandten Pflanzen steht keine Blattform jener unseres Fossiles so nahe, als die Blattform von *Zelkova crenata* Spach (*Planera Richardi* Mich.). Manche Blätter dieses ansehnlichen transkausischen Baumes sind, mit den fossilen zusammengehalten, bis auf die kleinste Schattierungen übereinstimmend... besonders aber die eigentümliche Zahnung des Randes, die Form des Basis, die Nervation ja sogar die scheinbar zweizeilige Stellung und der Wechsel in der Grösse ist hier so, wie in der fossilen Pflanze". However, in spite of all these facts, UNGER still described his species as an *Ulmus,* and it is therefore necessary to transfer it to the genus *Zelkova* where it undisputably belongs. Why it has not been transferred earlier, in view of the fact that its identity with *Zelkova ungeri* was commonly known, is rather obscure. Perhaps this was due to the added drawings of elm fruits, with authors assuming that UNGER's species could therefore not be transferred to the genus *Zelkova.*

Thus the hitherto commonly used name *Zelkova ungeri* is now a synonym, but authors cited for this name are frequently incorrect, which induced me to deal with

this problem when investigating the nomenclature of the species. The author of this genus is frequently cited as KOVATS and sometimes ETTINGSHAUSEN, both from the year 1851. However, the t r u e a u t h o r of *Planera ungeri* is undoubtedly ETTINGSHAUSEN, as I shall show further on. The basis for KOVATS' authorship is the report from the 6th session of the Imperial Geological Institute in Vienna of the 13th May 1851: "Die von Hrn. V. KOVATS glücklich aufgefundenen Früchte bestätigen auf's Glänzendsten die Wichtigkeit der zuerst von Dr. C. v. ETTINGSHAUSEN ausgesprochenen Ansicht, dass sie sämmtlich zu ein und derselbe Art des Geschlechtes *Planera* und zwar nach Hrn. Dr. I. v. KOVATS zur Untergattung *Zelkova* angehören. Sie wurde zu Ehren des um die Kenntnis der fossilen Pflanzenwelt so hoch verdienten Hrn. Professor FR. UNGER *Planera (Zelkova) Ungeri* genannt" (ANONYMUS*) 1851 b). From this it appears clear that: 1. ETTINGSHAUSEN was the first to know this species even if he placed it in the genus *Planera;* 2. As this was only a report from the session there was no description of the species, so that KOVATS' species was only a "nomen nudum" which has no priority ; 3. KOVATS quite clearly placed this species in the genus *Planera,* and not *Zelkova.* It is, however, remarkable that both ETTINGSHAUSEN and KOVATS gave their species the same specific name and each, naturally, added his name as the author. This may be explained by the fact that both (independently of each other) recognized UNGER'S *Ulmus zelkovaefolia* as the same species, and, as UNGER was one of the most prominent palaeobotanists of his time, named it in his honour (probably again independently of each other). Whilst it is certain that KOVATS' report to the meeting had been printed some months earlier in 1851 than had been ETTINGSHAUSEN'S work (KOVATS read his paper on 13th May, whereas ETTINGSHAUSEN dated the introduction to his work as 1st July, though both were printed later), KOVATS published only a mere name, which, as has been stated above, has no nomenclatural standing. ETTINGSHAUSEN, on the other hand, published a t h o r o u g h d e s c r i p t i o n complete with synonymy a n d i l l u s t r a t i o n, so, undoubtedly, he must be considered the author of the species. Its priority is confirmed also by the following minutes of the 5th session of the Imperial Geological Institute held on the 4th February 1851 (i.e. about three month before KOVATS read his paper) ; "Hr. Dr. Constantin von ETTINGSHAUSEN legte eine Abhandlungen über die fossile Flora der Umgebung von Wien vor, die zur Veröffentlichung bestimmt ist ..." (ANONYMUS 1851a). As *Planera ungeri* is described in this particular work, clearly ETTINGSHAUSEN'S name has priority. KOVATS did not include (his) *Planera ungeri* in the genus *Zelkova* until 1856 (when he gave an extensive synonymy), the correct author citation being *Zelkova ungeri* (ETTINGSH.) KOVATS.

Ulmus parvifolia A. BRAUN 1845 is also sometimes cited as a synonym. However, from BRAUN's description („U l m u s p a r v i f o l i a *mihi.* Einer kleinblättrigen Ulmus campestris ähnlich, kaum doppelt gesägt, indem sich unter jedem grösseren Zahn nur ein kleinerer befindet") it is obvious that his species does not belong to the genus *Zelkova,* which has leaves with prominent single serrations. BRAUN's *Ulmus parvifolia* is (at least in part) *U. minuta* GOEPP. (see under that species) and therefore cannot be considered as a synonym. Besides, even if BRAUN's *U. parvifolia* 1845 were actually identical with *Zelkova zelkovaefolia,* this name could not be used, as there exists a recent species, *Ulmus parvifolia,* which was described by JACQUIN from China in 1798, and has priority.

The fossil *Zelkova zelkovaefolia* may be compared with two recent species: *Zelkova carpinifolia* (PALL.) K. KOCH [= *Z. crenata* SPACH, *Planera richardii* MICHX., *Abelicea ulmoides* KZE.) and *Zelkova serrata* (THUNB.) MAK. [= *Z. acuminata* (L.) PLANCH, *Z. keaki* MAXIM, *Planera japonica* MIQ.]. *Zelkova*

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*) It is bibliographically correct to cite u n s i g n e d r e p o r t s on papers read at meetings etc. as ANONYMUS, as they are mostly written not by the authors of the reports but by secretaries of the societies etc.

carpinifolia is a tree up to 25 m tall, indigenous to the Caucasus and northern Iran. It has crenate-serrate, elliptical leaves, 2—6(9) cm long, with 6—8 secondary nerves, and a drupe measuring 5 mm. *Zelkova serrata* is a tree up to 30 m tall, indigenous to Japan, China, and Korea, and has sharply serrate, ovate leaves, distinctly prolonged at the apex, 3—8(12) cm long with 8—13 secondary nerves, and a drupe measuring 4 mm (PILÁT 1953, ČEREPANOV 1957). However, our fossil species possesses characters of both of these species (KRÄUSEL 1920); with its somewhat elongated apex and the rather sharply serrated margin of the leaves it approaches the Japanese species *Zelkova serrata,* but the smaller leaves (which are fairly constant), and particularly the smaller number of secondary nerves and teeth, suggest the Caucasian *Zelkova carpinifolia.* Amongst the fossil species, *Zelkova praelonga* (UNG.) BERGER is distinguished by its sharply serrated leaves, which are, however, much larger (10—12 cm long and about 4 cm broad). In addition, it cannot be excluded that the fossil *Zelkova zelkovaefolia* was the ancestor of both recent species (SZAFER 1961), as it possesses characters common to both and it is known not only from Europe but also from Japan. On the other hand it is, of course, also possible that two or more distinct fossil species have been described under the name *Zelkova ungeri,* as it is commonly named in publications, some of which belong to the type of *Zelkova carpinifolia* and others to *Z. serrata.* This is implied, also, for example, by the illustrations of *Zelkova ungeri* in HEER (1856), tab. 80, which show very heterogeneous types of leaves, varying from very small ones (1.5—3 cm) resembling the recent Cretan *Zelkova cretica* (SM.) SPACH, to large leaves with up to 15 teeth but without an elongated apex.

Ebenaceae (Diospyraceae)

cf. *Diospyros brachysepala* A. BRAUN — Tab. V. fig. 1, tab. VI. fig. 5

This is the third, most frequent fossil plant of the neogeneous flora of Bory, and has been found about 13 times. However, the material which I have examined includes two somewhat different types: 1. with narrowly elliptical leaves, and 2. with leaves varying from short elliptical to almost ovate and more strongly curved secondary nerves which are less dichotomously branched towards the margin. Recent species of *Diospyraceae,* e. g. *Diospyros kaki* L., *D. lotus* L. (both indigenous to Asia), and *D. virginiana* L. (N. America), are low trees reaching a height of 10—15 m (PILÁT 1953), the leaves of which come nearest to the fossil impressions, have a less regular, rather curving and little branching secondary nervation, and, on the whole, are always large (6—13 cm), whereas the present species has much smaller leaves (5—7 cm). In addition, the leaves of the present species are obtusely acuminate, whereas the recent species have sharply acuminate leaves. Obtusely acuminate leaves are also characteristic for both *Diospyros ibo* GÜRKE and *D. ebenum* KOEN., with the latter resembling the narrowly elliptical type in many characters (though tropical and indigenous to Ceylon and India), whereas *Diospyros kaki* most closely resembles the short elliptical to ovate type. Considering that the fossil *Diospyros brachysepala* was originally described from the calyx, the possibility cannot be excluded that leaves later ascribed to it belonged to several species.

Aceraceae

Acer spec.

Impressions belonging to this genus are rarely found and are mostly in such a bad state of preservation as to make it almost impossible to determine the species.

Rhamnaceae

Rhamnus gaudinii HEER — Tab. V, fig. 2, 3

The second most common species found in the Bory location, collected about 18 times (one very fine impression and counterimpression), is easily distinguishable by the spinose-dentate margin of its leaves and their typical secondary and tertiary nervation. The size of the leaves fluctuates considerably from 2—5 cm up to 18 cm, but the other characters are quite constant, so there is no doubt that they belong to a single species. Of the recent species, the fossil *Rhamnus gaudinii* is resembled most closely by *Rhamnus grandifolia* FISCH. et MEYER [= *Frangula grandifolia* (FISCH. et MAYER) GRUB.], a shrub up to 3 m tall, indigenous to the Caucasus and northern Iran (PILÁT 1953), the leaves of which strikingly resemble the extinct species.

Incertae sedis

Monopleurophyllum quercifolium (GOEPP.) KOTLABA comb. nov. — Tab. V, fig. 4, 5

Basonym: *Rhus quercifolia* GOEPPERT, Die tertiäre Flora von Schossnitz in Schlesien p. 37, tab. 25, fig. 6—9, 1855.

Synonyms: *Rhus aegopodifolia* GOEPP 1855; *Monopleurophyllum hungaricum* ANDR. 1959.

A further, rather common species of the fossil flora, found about six times (twice comprising positive and negative impressions). This interesting plant has compound trifid leaves, with the middle leaflet having a prolonged petiole. However, we have never found a whole leaf of this form, and from other European localities mostly only single leaflets (varying somewhat in size) are known, which indicates that the leaves were very prone to disintegration. The single leaflets are 3—11 cm long and, together with the lobes, 2—7 cm broad. Two more or less symmetrical lobes occur rarely, and are probably middle leaflets of a compound leaf. Most frequently we find distinctly asymmetrical lateral leaflets, usually with one large (1—2.5 × 0.5—2 cm) and a few (2—5) smaller lobes or rather prolonged irregular teeth; otherwise these leaves are entire or with only faintly indicated teeth.

In the literature the species is only occasionally mentioned, although GOEPPERT described it under the name *Rhus quercifolia* in 1855, but in a rather rare work (there is probably no copy available in Czechoslovakia). Having at first at my disposal no literature containing a good illustration and description of *Rhus quercifolia,* I determined the Bory finds according to ANDREÁNSZKY (1959) as *Monopleurophyllum hungaricum* ANDR. (it would appear that ANDREÁNSZKY was unaware of GOEPPERT'S work or even the further work given below). The identity of my material with *Rhus quercifolia* was pointed out to me by Prof. F. NĚMEJC at the Faculty of Natural Sciences of

the Charles University, Prague, to whom I am very grateful indeed. He also lent me the book edited by KRÄUSEL „Die Pflanzen des schlesischen Tertiärs" (written by five authors), which, in some aspects, is also a revision of GOEPPERT'S species. A thorough comparison of my material with the description and illustrations of this book (the corresponding part of which had been worked out by E. MEYER 1919), and, further, with the description and illustrations in ANDREÄNSZKY (1959), has led me to the conclusion that I am dealing with one and the same species. The problem was, of course, to decide whether this species actually belongs to the genus *Rhus* or not.

In the literature, *Rhus quercifolia* is commonly compared with the recent North-American *Rhus toxicodendron* L. MEYER (1919) writes in this connection: "Es kann keinem Zweifel unterliegen, dass er mit *Rhus toxicodendron* L. aus Nordamerika sehr nahe verwandt ist, und deshalb bleibt es ganz unverständlich, weshalb ENGLER ... die GOEPPERT'sche Art als mit keiner rezenten vergleichbar hinstellt. Höchstens *Acer Negundo* L. könnte allenfals noch zum Vergleich herangezogen werden. Doch ist bei der wirklich völligen Gleichkeit der Abdrücke mit Blättern von *Rhus toxicodendron* L. die Bestimmung GOEPPERT's beizubehalten". *Rhus quercifolia* was dealt with in the following year by KRÄUSEL (1920), who was somewhat reserved regarding its relationship with the American species, writing: "Dieser fossile Formenkreis wurde mit *Rhus toxicodendron* L. verglichen. In der Tat sind die Blätter der lebenden Art sehr variabel, und schwer findet man, wenn auch nicht allzu häufig, unter ihnen auch die schmäleren Formen des tertiären Typus wieder, die hier zu überwiegen scheinen ...". Recently (Švarova, 1962) *Rhus quercifolia* has been compared with *R. toxicodendron* L. var. *quercifolia* (MICH.).

I have studied herbarium material comprising leaves of *Rhus toxicodendron* very thoroughly and, having compared them with the fossil plant, have come to the clear conclusion that, even if some leaves show at first sight a considerable resemblance, there are still such significant differences in the basic botanical characters that they cannot be placed in the same genus: 1. The leaflet of a compound leaf of the fossil species always has 1—2 distinctly developed large lateral lobes, whereas these structures occur only in rather exceptional cases with *Rhus toxicodendron,* when they do not form the typical lobe but resemble an atypically enlarged and prolonged tooth; 2. The secondary nerves of the leaflet of the fossil species, numbering 3—7, are generally rather scanty, moderately arched, and rise from the midrib forming a broad angle of 40—50^0, but the lowest secondary nerves (in the case of two large lobes) or one nerve (in the case of a single lobe) are much more conspicuous than the remainder and rise at a more acute angle, 30—40^0, which is a typical, constant, and very distinctive character. *Rhus toxicodendron,* on the other hand, has most often 5—10 secondary nerves, all of which are generally more or less parallel, equally conspicuous, and all rise at an angle of 40—50^0, including the nerve ending in the lobe; 3. The tertiary nervation in the lobe (lobes) of the fossil species is almost vertical to the secondary nerve (i. e. the central nerve), and terminates typically in dichotomous branching, and comptodromously fuses in the margin of the leaf. Even if the secondary and tertiary nervation branches dichotomously towards the leaf margin in *Rhus toxicodendron,* it never fuses but leads to the leaf margin. From this it is obvious that the fossil *Rhus quercifolia* is not a species of the genus Rhus at all, as not a single species of this genus, (which is rich in species, particularly in America) can be compared with the fossil plant.

Further, among other genera of recent plants no similarity with the fossil species could be found (although theoretically there should exist a recent genus to which this fossil species belongs — it is, after all, a species of the flora of the younger Tertiary — however, it may be that it is a species of an extinct genus) and I have therefore considered it desirable to transfer *Rhus quercifolia* GOEPP. to ANDREÁNSZKY's new genus *Monopleurophyllum.* I believe this to be correct (especially since this genus already exists in literature, and it is therefore not necessary to add a new generic name), rather than leave the species in a genus to which it quite definitely does not belong.

When decribing his new genus and species, ANDREÁNSZKY (1959) had no impression of whole compound leaves at his disposal, so that he did not suspect that these leaves were only leaflets of a compound, trifid leaf, and therefore it is necessary to supplement his otherwise thorough diagnosis with the appropriate data. In addition, according to the new edition of the International Code of Botanical Nomenclature (1961) generic-specific description of fossil plants published after January 1st 1953 are not regarded as having been validly published (and ANDREÁNSZKY'S description is generic-specific). I therefore emend and validate the genus *Monopleurophyllum* ANDR. as follows:

Monopleurophyllum ANDREÁNSZKY gen. nov.

The leaves are compound, trifid, with an elongated petiole of the middle leaflet. The single leaflets of the compound leaf are irregularly 1—3 lobate, 3—11 cm long and 2—7 cm broad, with 3—7 secondary nerves and tertiary nerves branching dichotomously towards the margin where they fuse comptodromously.

Typus: *Monopleurophyllum hungaricum* ANDREÁNSZKY 1959.

It is interesting to note that both MEYER (1919 — see citation above) and ANDREÁNSZKY (1959) point out the resemblance of the leaves of the fossil species to those of *Acer negundo* L. (= *Negundo fraxinifolia* NUTT) quite independently. ANDREÁNSZKY writes: „Die grosse Übereinstimmung der stark asymmetrischen und der mehr oder weniger symmetrischen Blätter kann nur so gedeutet werden, dass es sich um ein fiederig zusammengesetztes Blatt handelt. Solche stark asymmetrische und nur gegen die eine Seite zugelappte Blätter finden wir unter den rezenten Holzarten nur bei *Acer negundo* L. und übrigen Ahornarten der Sekt. *Negundo.* Wir sind der Meinung, dass es sich hier um eine ausgestorbene Art der Sektion *Negundo* handelt". Nevertheless, as ANDREÁNSZKY (quite correctly) did not place this species in the genus *Acer,* but created for it the new genus *Monopleurophyllum,* he must have been well aware of the considerable differences between them. It is, however, not possible to assume any relationship between the fossil and *Acer negundo,* as, although the leaves of this maple are sometimes also trifid but most frequently pinnate, and occasionally form lobes in a similar way, they differ basically as regards the type of nervation (particularly of the tertiary). Therefore ANDREÁNSZKY'S placing of *Monopleurophyllum hungaricum* in the family *Aceraceae* cannot be considered correct. Which is the proper place of *Monopleurophyllum* in the system I cannot say at present, as I am still doubtful as regards its relationship with other taxa.

According to MEYER (1919), GOEPPERT'S *Rhus aegopodifolia* is identical with *R. quercifolia.* He says: „Die Stellung von *Rhus aegopodifolia* GOEPP. (t. 25, f. 10) erschien angesichts des Fehlens des Originals etwas ungewiss. Nun fand ich aber nachträglich einen Abdruck aus Schossnitz, in dem wir zwar nicht das Original selbst, unzweifelhaft aber seinen Gegendruck vor uns haben. Dieses Blatt ist kaum von *Rhus quercifolia* zu trennen, weshalb wir wohl berechtigt sind, die beiden Arten Goeppert's zu vereinigen".

As regards the stratigraphical distribution of *Monopleurophyllum quercifolium,* it seems (even if it is rarely mentioned in the literature as it has probably not always been correctly identified) to be typical for the younger Tertiary, particularly for the Tortonian and Sarmatian sediments, and is probably quite unknown from Bohemia. As far as I could ascertain, *Rhus quercifolia* is recorded from Bohemia (from the Želenky locality) only by BRABENEC (1909), who apparently copied data from ENGELHARDT (1891, p. 193—194). The illustration of a leaf fragment by this author in tab. 8, fig. 23, however, does not correspond with this species, and I am therefore of the opinion that it should be excluded from the Bohemian fossil flora pending further discoveries. The apparent absence of *Monopleurophyllum quercifolium* is, however, in conformity with the stratigraphy of the main sedimentary phase of the North-Bohemian Tertiary of lower to middle Miocene age. From Slovakia, *Rhus quercifolia* has been recorded only by NĚMEJC et PACLTOVÁ (1956) and NĚMEJC (1957) from clayey to finely sandy slate on the right-hand bank of the mouth of the Bystrička brook between Bystrička and Turec. The geological age is given as the era between the Tortonian and the Sarmatian (1956) and the Upper Sarmatian (1957), which conforms substantially with the age of the sediments from the Levice neighbourhood.

The Fossil Flora from the Domadice Locality

The Domadice locality in the Levice district lies more than 2 km due south of Bory and about 13 km southeast of Levice. It was discovered probably by A. PETREK of Domadice, a retired head-master, who took us to an old, disused quarry north of the village where the fossils had been collected, and untiringly showed us round, for which we extend to him our heartiest thanks. Here the fossil flora is also found in andesitic tuff and tuffite, which are, however, much more coarsely grained than at the Bory locality. Most of our collections came from pieces of rock that had been broken years ago when the quarry was still being worked (others were from deeply eroded chines), but they were all in an advanced stage of erosion. The flora found here, although not very rich, is rather interesting.

Equisetaceae

Equisetum aff. *arvense* L. — Tab. VI, fig. 3, 6

A rather common fossil, of which five specimens were collected, and comprise impressions of stalks, sometimes together with sheaths and teeth, and the fillings of the stalk internodes. This fossil species approaches in its characters the recent *Equisetum arvense* L., but its identity is uncertain in view the fragmentary nature of the material.

Hamamelidaceae

cf. *Liquidambar europaea* A. BRAUN

There is only a single specimen, which has not been definitely determined because of the bad state of preservation of the leaf margin. However, the overall shape, and particularly the nervation, point to *Liquidambar europaea.* Otherwise this species must have been very rare in the local flora, as it was found only once at Bory, and is unknown from Brhlovce.

Parrotia pristina (ETTINGSH.) ŠTÚR

There is also only one but very well preserved specimen, even though the impressions are in rather coarse tuff. Unlike the species of the genus *Liquidambar, Parrotia pristina* seems to have been a constant component of the neogeneous flora of the Bory and Domadice area.

Fagaceae

Fagus attenuata GOEPP. — Tab. VI, fig. 1, 2

The second most common fossil from the Domadice locality, though known from only five collections. We obtained the finest impressions as a gift from the collections of the local school at Domadice. There are impressions of three leaves close to each other in a rather finely grained piece of tuffite, and on the underside is the impression of a fourth leaf.

Fagus attenuata has oblong-elliptic to ovate leaves with a rather obtuse apex, 4—8 cm long and 2—4,5 cm broad, with a short, spinose-dentate leaf margin, and 9—11 secondary nerves, which are absolutely straight and terminate in finely forward-curving marginal teeth. The recent specimen most closely related to the fossil *Fagus attenuata* is the North-American *Fagus grandifolia* EHRH. (=*F. ferruginea* AIT., *F. americana* SWEET), a tree up to 30 m tall with large leaves (6—12 cm), often with an elongated apex, 11—15 secondary nerves, and a finely dentate leaf margin of similar character to the leaves of the fossil species. The common European *Fagus silvatica* L. and the Caucaso-Balkan *Fagus orientalis* LIPSKY have entire leaves or leaves with an undulate to very short dentate margin, mostly broadly elliptical, with 6—9 somewhat uneven (often a little undulating) secondary nerves (these two species differ from each other by the indumentum of the cupule — *Fagus silvatica* has a cupule covered with sharp spines, whereas that of *F. orientalis* has flattened to almost bandlike appendages) and hence are not related to the fossil *Fagus attenuata* GOEPP. The problem of the fossil beeches was studied by NĚMEJC (1949), SZAFER (1961) and, especially, TRALAU (1962).

I have not seen GOEPPERT'S original description of *Fagus attenuata,* but the description and illustration of the species in R. REICHENBACH (1919), who also revised GOEPPERT'S material, conforms well with the material under discussion. In addition, REICHENBACH also points out an interesting character in the tertiary nervation: in the American and the fossil species, the tertiary nervation (running between the secondary nerves) breaks up in the centre into a fine netlike pattern, and only a few tertiary nerves continue from one secondary nerve to the other (which, on the other hand, is common in other beech species).

ANDREÁNSZKY (1959) described a total of four new species of fossil beeches, the specific value of which, however, seems to me rather doubtful (some are described on the basis of only a single leaf!). According to TRALAU (1962) these fossils belong to the *Fagus silvatica* group. However, ANDREÁNSZKY does not mention *Fagus attenuata* GOEPP. at all and was obviously unaware of either GOEPPERT'S work on Schossnitz or the book edited by KRÄUSEL on the flora of the Silesian Tertiary.

Castanea spec.

A single, very time-worn and badly preserved impression of an incomplete leaf, perhaps a relative of the recent *Castanea mollissima* BLUME, indige-

nous to China and Korea, which is a tree up to 20 m tall with ovate-lanceolate, 8—12 cm long leaves (PILÁT 1953). It was, however, impossible to carry out a more accurate classification. Similar leaves are mentioned by SZAFER (1961).

Aceraceae

Acer spec.

We found only two impressions of leaves, but, because of the bad state of preservation, particularly of the margins, they could not be determined more accurately.

Lauraceae

cf. *Laurus princeps* HEER

There was only a single impression of an incomplete leaf but with a well preserved nervation allowing more precise determination (see under Brhlovce for further details). This species must have been very rare at the Domadice locality.

It is remarkable that we did not find a single impression of *Ulmus braunii, Rhamnus gaudinii* and *Diospyros brachysepala* at the Domadice locality as they were the most common fossils at the Bory locality. Nevertheless, I am convinced that the floras of both localities are identical.

The Fossil Flora from the Brhlovce Locality

The Brhlovce locality in the Levice district lies somewhat less than 4 km north of Bory and Domadice, and approx. 10 km due east of Levice. I found this locality, together with V. BARTOŠ, by mere chance whilst visiting the Museum of National History at Levice in 1961. There we found several impressions of plants together with data stating the locality where they had been found, which was ascertained to be a quarry north of Dolní Brhlovce, where tuff and tuffites are at present being machine-cut. Immediately afterwards, however, we found a new locality at Horní Brhlovce with a different flora. I shall deal with the two localities separately as they are kept distinct on the old maps, though both places have now been united into one village called Brhlovce.

Dolní Brhlovce

Here the fossil flora is found scattered in coarse tuffite and tuff, which, in places, disintegrate very easily. The tuffite is being machine-cut for use as building material resembling blocks or other artificially produced building material. The quarry is situated on the north-western border of the village and exposes a large piece of land on the right side of the Bur brook. The flora is similar to that found at Bory and Domadice, but, because of the bad state of preservation in the coarse tuffite, we were able to determine only two species, i.e. cf. *Castanea* aff. *dentata* BORKH. (a very badly preserved piece of an impression of a leaf) and *Ulmus braunii* HEER (a total of three impressions).

Horní Brhlovce

When investigating the neighbourhood of Brhlovce we chanced to discover a new, rich locality of the fossil flora southsoutheast of Horní Brhlovce

near a place marked on the map as „Zastávka" near elevation point 163 m, in the cutting of a recently constructed path-way leading up a slope at the mouth of a side valley entering the Bur valley. Here there was such an accumulation of leaf impressions at one place, that it was almost impossible to select some at least partly preserved impressions that did not overlap too much. The impressions are in very finely grained tuffite and therefore well preserved, so that even the tertiary nervation is clearly visible. However, we were only able to spend about half an hour at this locality, and therefore collected very little material, all of which were impressions of bay leaves. It seemed, however, that there were no other leaves there.

cf. *Laurus princeps* HEER — Tab. VI, fig. 7

We found a total of eight impressions of leaves of this species, which has rather fine and dense secondary nerves (12—18) that develop at an angle of considerable breadth, 45—55°, and, compared with the secondary nerves, the main nerve is very robust. *Laurus princeps* is usually compared with the recent *L. canariensis* L., which also has a great number of secondary nerves, though they rise from the midrib at an acute angle of 25—30°. *Laurus nobilis* L., on the other hand, resembles rather the fossil species as regards the angle of its secondary nerves (it is broader, 35—40°), but the number of secondary nerves is small — a mere 8—12. It is therefore difficult to decide to which recent species the fossil *Laurus princeps* is closer. If we consider the number of secondary nerves as the more important character, then it is closer to *L. canariensis;* however, if we consider the angle of the secondary nerves more important, then it is decidedly more closely related to *Laurus nobilis* L., which is a shrub or tree, 5—18 m tall, probably originating from the Asian part of the Mediterranean, and at present spreading all over the Mediterranean region (PILÁT 1953). *Laurus canariensis* L., on the other hand, is a tropical and subtropical tree, which, for ecological reasons, can hardly be compared with our fossil *L. princeps* HEER. In addition, *L. canariensis* always has small g l a n d s in the axil of the secondary nerves, whereas our fossil species has none (although the impressions are very fine!). Comparison is very difficult, and the possibility cannot be excluded that it might be a representative of a different but similar genus.

This bay-tree locality near Horní Brhlovce is in a lower terrain than the Dolní Brhlovce locality. It is therefore possible (also taking into consideration the different flora) that it is also somewhat older stratigraphically.

C o n c l u s i o n

Taking into consideration the occurence of some common species, the identical character of the rock-formations, the approximately identical elevation of the localities (about 160 m), and the close proximity of the localities, I c o n s i d e r t h e f l o r a s o f B o r y , D o m a d i c e , a n d D o l n í B r h l o v c e o f e q u a l a g e (though the Horní Brhlovce flora may be somewhat older). On the whole, this flora doubtlessly belongs to the u p p e r M i o c e n e, but its stage remains an open question. Judging by the remarkable absence of the representatives of some genera (e.g. species of the genus *Cinnamomum* are

entirely missing) and by the occurrence of some species that are very close to or almost identical with recent species (*Juglans* aff. *regia, Castanea* aff. *dentata, etc.),* it can be assumed to be a very young flora that may be placed most probably in the lower Sarmatian or the upper Tortian. More accurate conclusions may be arrived at only through further research, i. e. if either further macroflora is found or — and in particular — if a palynological investigation is carried out or any fauna are found.

According to the flora ascertained, a rather warm and mildly moist climate of a mesophytic character may be assumed (only the bay-trees at Horní Brhlovce point to a rather dry climate). The overall character of the vegetation was determined from the foliaceous plants, chiefly trees and, less frequently, shrubs, elements related to some recent Caucasian, Sino-Japanese, and partly also North-American species.

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EXPLANATIONS TO THE PLATES

Tab. I. Side of the valley at Bory containing derelict tunnels in andesitic tuffite (overhead). One of the tunnels in the valleyside at Bory where impressions of the fossil flora occur (under).

Tab. II. Collecting samples of impressions of the fossil plants from tuffite blocks which are being brought out from derelict tunnels in the valleyside at Bory. The illustration shows V. Bartoš, the conservator of the Department of Geology and Palaeontology of the National Museum, Prague (overhead). The quarry north of Brhlovce with a fossil flora in tuffs and tuffites. These are being mechanically cut for building material (under).

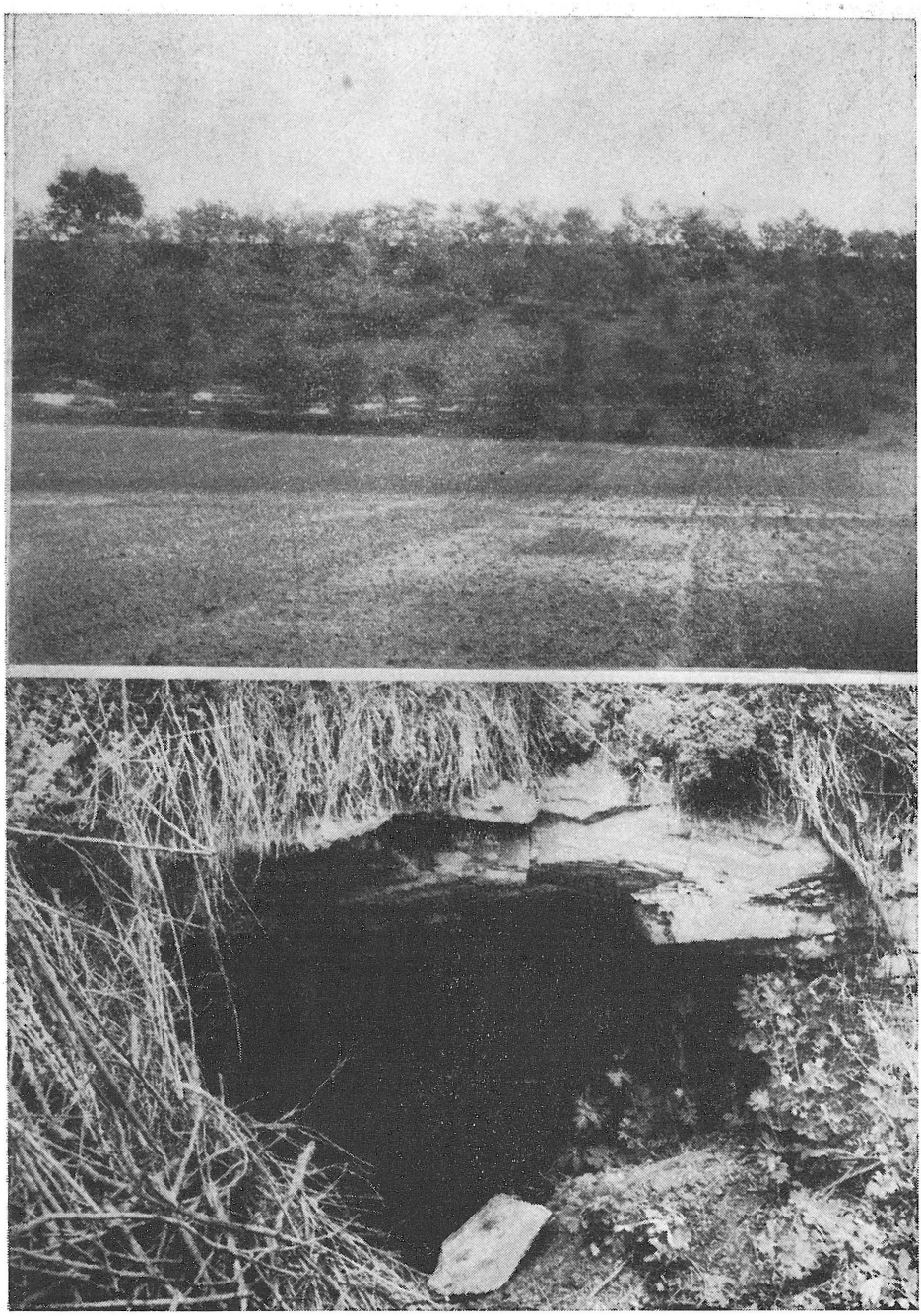
Tab. III. Fig. 1. *Glyptostrobus europaeus* (BRONGN.) HEER. Bory, 18. V. 1959 leg. F. Kotlaba et V. Bartoš. — 2. *Cercidiphyllum crenatum* (UNG.) BROWN (positive and negative). Bory, 18. V. 1959 leg. F. Kotlaba et V. Bartoš. — 3. *Parrotia pristina* (ETTINGSH.) ŠTÚR. Bory, 16. V. 1959 leg. F. Kotlaba et V. Bartoš. — 4. *Parrotia pristina* (ETTINGSH.) ŠTÚR (well preserved tertiary nervation). Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 5. *Salix* cf. *media* HEER. Bory, 16. V. 1959 leg. F. Kotlaba et V. Bartoš. — 6. *Populus latior* A. BRAUN. Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 7. *Zelkova zelkovaefolia* (UNG.) BŮŽEK et KOTLABA (fruit). Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 8. *Zelkova zelkovaefolia* (UNG.) BŮŽEK et KOTLABA. Bory, 2. VI. 1958 leg. F. Kotlaba et V. Bartoš.

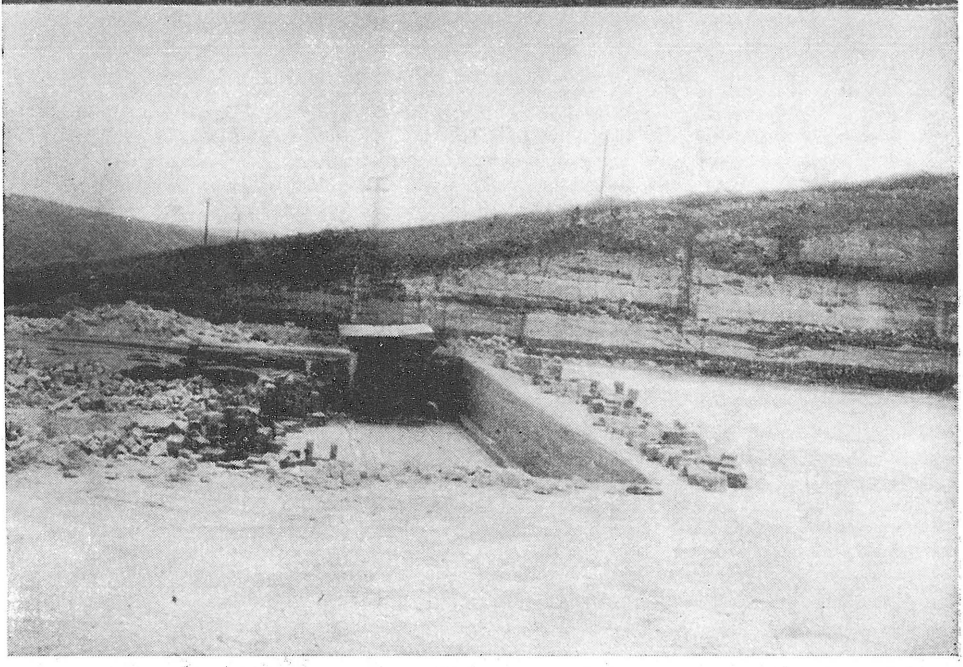
Tab. IV. Fig. 1. *Castanea* aff. *dentata* BORKH (positive and negative). Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 2. *Ulmus minuta* GOEPP. (positive and negative). Bory, 25. V. 1955 leg. Vl. Zázvorka, A. Žertová et M. Doktorová. — 3. *Juglans* aff. *regia* L. Bory, 8. VI. 1960 leg. F. Kotlaba et V. Bartoš. — 4 *Ulmus braunii* HEER. Bory, 16. V. 1959 leg. F. Kotlaba et V. Bartoš. — 5. *Ulmus braunii* HEER. Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 6. *Pterocarya denticulata* (O. WEBER) HEER (left) and *Monopleurophyllum quercifolium* (GOEPP.) KOTLABA (on the right). Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš.

Tab. V. Fig. 1. cf. *Diospyros brachysepala* A. BRAUN (narrowly elliptical leaf). Bory, 8. VI. 1960 leg. F. Kotlaba et V. Bartoš. — 2. and 3. *Rhamnus gaudinii* HEER. Bory, 2. VI. 1956 leg. A. Žertová et M. Doktorová. — 4. *Monopleurophyllum quercifolium* (GOEPP.) KOTLABA (positive and negative). Bory, 20. V. 1959 leg. F. Kotlaba et V. Bartoš. — 5. *Monopleurophyllum quercifolium* (GOEPP.) KOTLABA. Bory, 18. V. 1959 leg. F. Kotlaba et V. Bartoš.

Tab. VI: Fig. 1. *Fagus attenuata* GOEPP. Domadice (a gift from the collections of the local school). — 2. *Fagus attenuata* GOEPP. Domadice, 15. V. 1961 leg. F. Kotlaba et V. Bartoš. — 3. *Equisetum* aff. *arvense* L. Domadice, 15. V. 1961 leg. F. Kotlaba et V. Bartoš. — 4. An atypical leaf of *Monopleurophyllum quercifolium* (GOEPP.) KOTLABA (without lobes). Bory, 2. VI. 1956 leg. A. Žertová et M. Doktorová. — 5. cf. *Diospyros brachysepala* A. BRAUN (short elliptical leaf). Bory, 15. V. 1959 leg. F. Kotlaba et V. Bartoš. — 6. *Equisetum*, aff. *arvense* L. Domadice, 15. V. 1961 leg. F. Kotlaba et V. Bartoš. — 7. cf. *Laurus princeps* HEER. Horní Brhlovce, 16. V. 1961 leg. F. Kotlaba et V. Bartoš.

Photographs of all impressions are actual-size. Photo Dr. F. Kotlaba.



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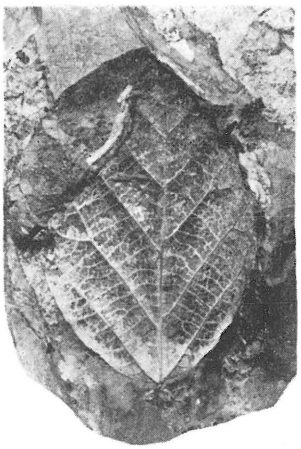
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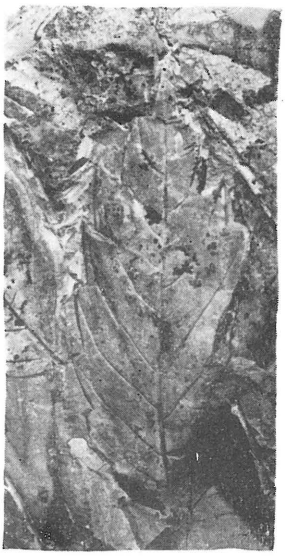


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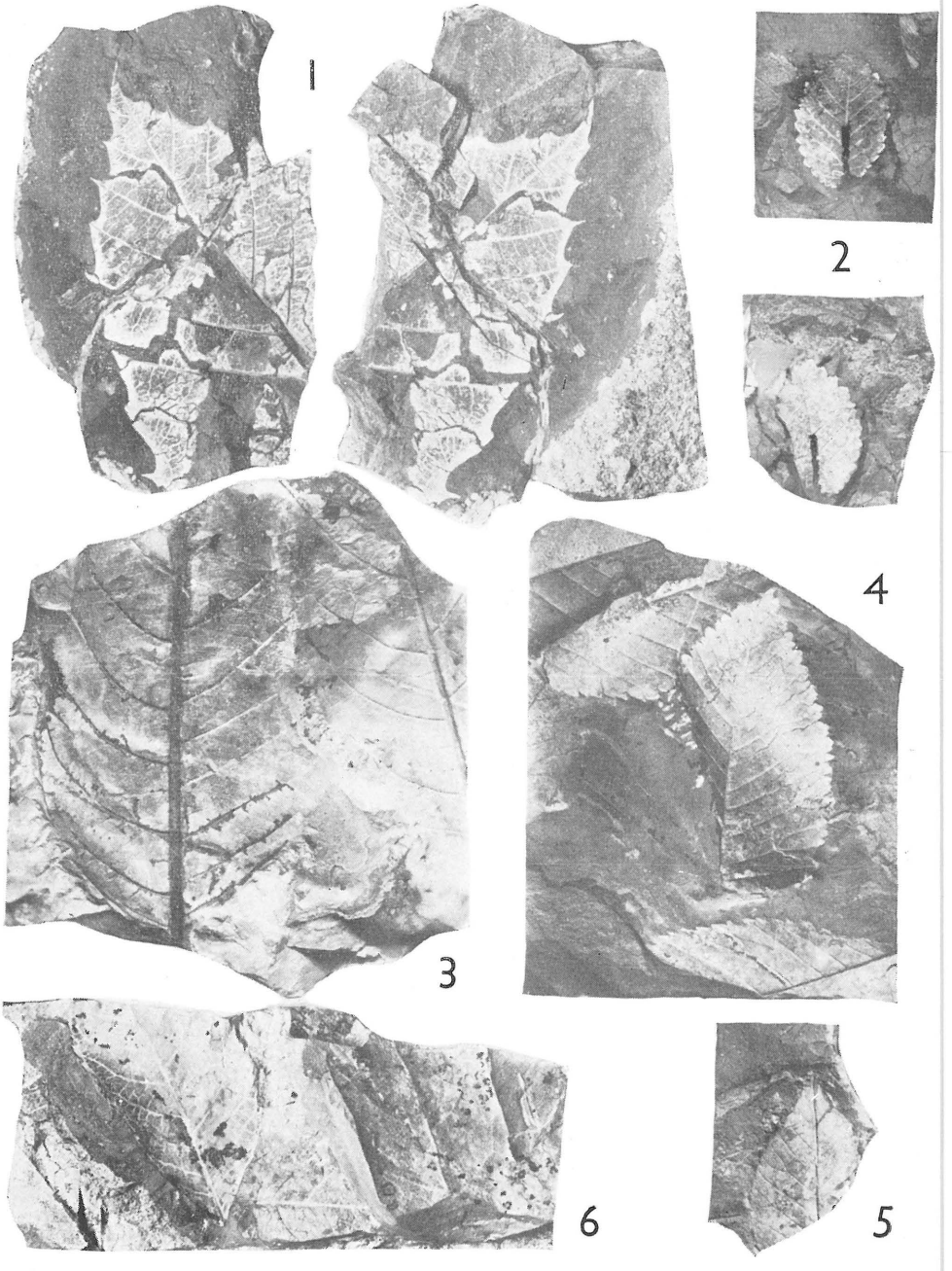
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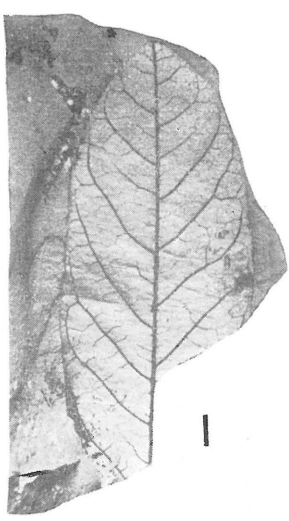

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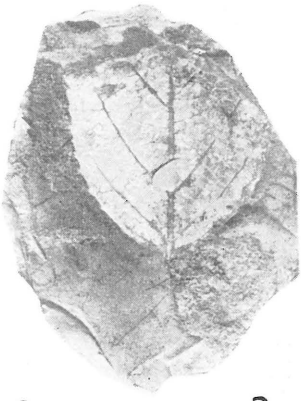

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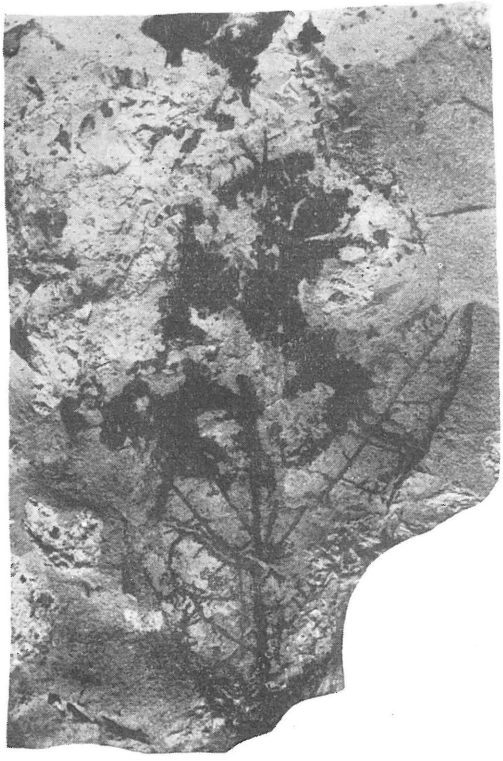

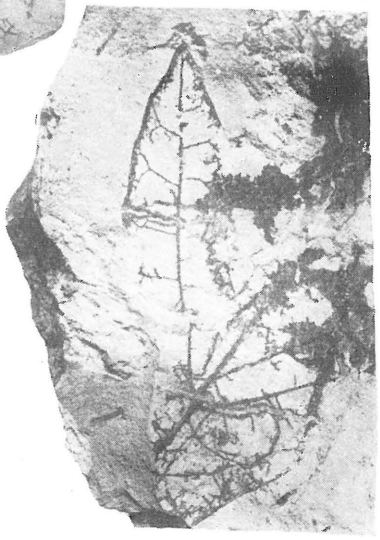

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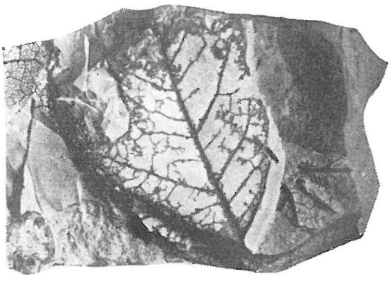

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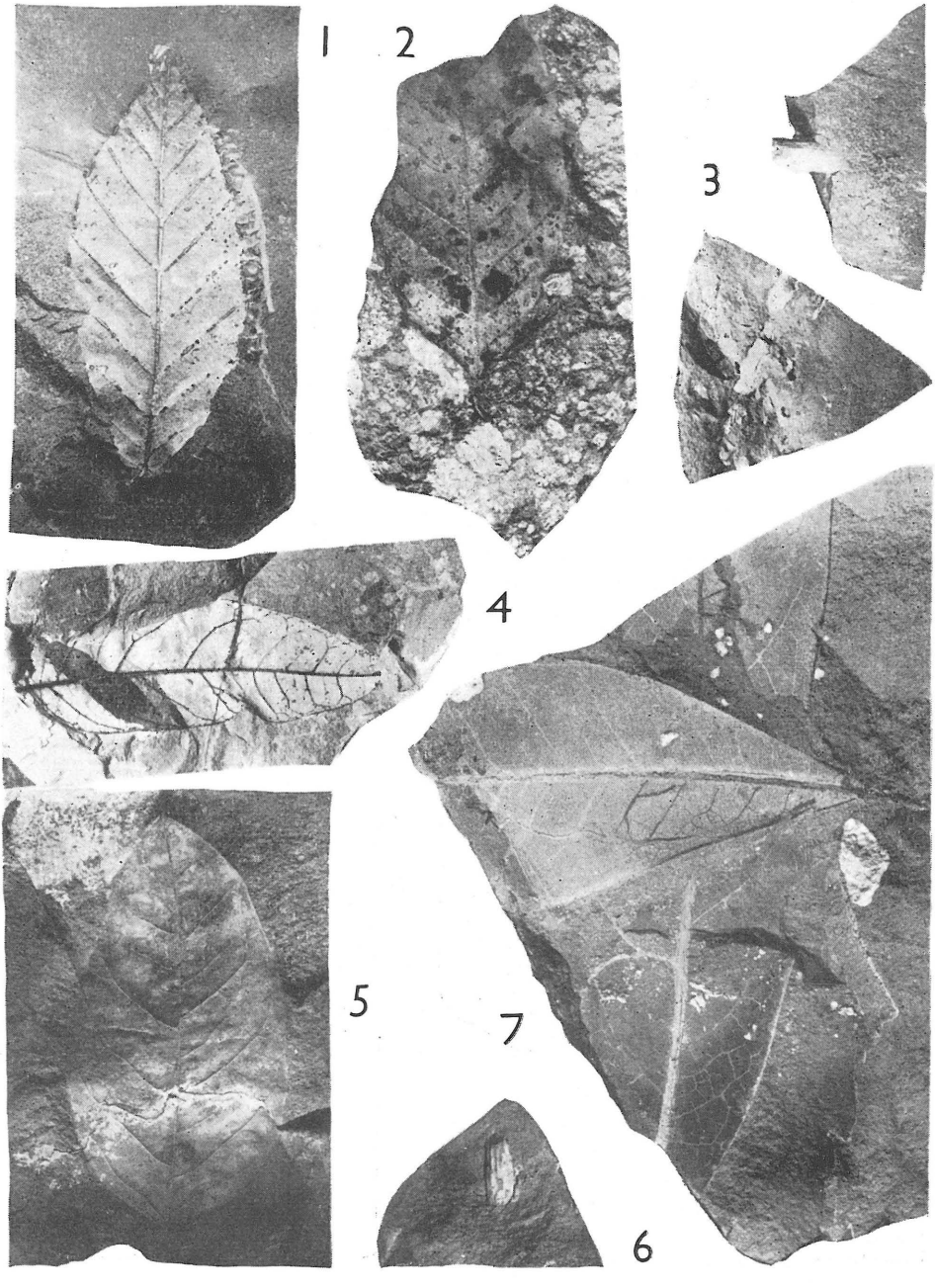
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