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Rostlinné otisky z železitých konkrací od Hrutova (u Lišova v jižních Čechách)

Fossil plants from the iron stones of Hrutov (near Lišov in S. Bohemia)

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PŘEDMLUVA

V následujícím anglicky psaném pojednání podávám podrobný rozbor rostlinných otisků ze železitých konkrací („železnáků“) pocházejících z pís-kového souvrství u Hrutova (severně od Lišova v jižních Čechách). Po-cházejí ze starých sběrů z doby působení Dra A. Friče a Dra J. Vele-novského v Národním Museu v Praze, kde představují poměrně neveli-kou kolekci ve sbírkách geologicko-paleontologického oddělení. Pro bližší poznání fosilních květů jihočeské pánve mají jistě nemalou důležitost, neboť paleontologické nálezy jsou v této pánvi vůbec zjevem vzácnějším. Nicméně jen od bližšího poznání takových nálezů můžeme očekávat spo-lehlivější stratigrafické zařazení sedimentů vyplňujících tuto pánev. Za laskavé zapůjčení celé kolekce otisků z hrutovských železnáků vděčím především Dru Vl. Zázvorkovi, přednostovi geologicko-paleontolo-gického oddělení Nár. Musea v Praze a sl. A. Žertové, která v tomto oddělení spravuje sbírky paleobotanické.

Hrutovské železnáky právě tak jako železité konkrece vůbec v celé jihočeské pánvi byly kdysi důležitou surovinou, která se zpracovávala jako železná ruda v některých místních jihočeských hutích. Jako všechny ulo-ženiny vyplňující jihočeskou pánev, byly většinou přičítány k mladším třeti-horám (neogenu) a s tohoto hlediska hodnotil také J. Velenovský otisky, které byly získány z hrutovských nálezů; originální označení jed-notlivých musejních kusů to dostatečně dosvědčuje. Bohužel jsou, zejména po stránce nervatury poněkud špatně zachované, což ve většině případů znemožňuje jejich naprosto přesné hodnocení taxonomické. Přesto jejich bližší studium vedlo celkem k dosti překvapujícímu výsledku, neboť místo domnělých neogenních rostlinných prvků (většinou byly považovány za třetihorní druhy rodů *Salix* nebo *Andromeda*) byly v nich seznány prvky

květen daleko starších, prvky jaké se uvádějí z období pozdní křídly nebo ranného paleogenu.

Pro nepřiliš vhodný způsob zachování (téměř nezatelná nervatura, zlomkovitý ráz některých nálezů, mnohde i nejasně zachované okraje listů) bylo možno přesněji definovati jen některé významnější případy. Jinak jsem raději použil, jak bývá dnes obzvláště u takových geologicky starších nálezů zvykem, kde přesnou taxonomii nelze zaručiti, umělého rodového názvu *Dicotylophyllum*, které nás k ničemu nezavazuje. Z otisků, které tu můžeme bezpečněji porovnat s nálezem známými již odjinud, uvádím zejména tyto: Koniferové větvičky rázu *Sequoites primaeva* (C d a.) Reuss, dlouhé a silné jehlicovité listy vzhledu borových jehlic známých jako *Pityophyllum* sp., *Myricophyllum zenkeri* E t t. sp., *Myricophyllum serratum* V e l. sp., *Alniphyllum kefersteini* U n g. sp. (viz B. B a y e r 1896), *Dewalquea insignis* H o s. et v. d. M., *Dewalquea haldemiana* H o s. et v. d. M. I když bychom připustili vzhledem k poměrně špatnému způsobu zachování i možnou záměnu s některými jinými podobnými nálezem jiné taxonomické hodnoty, přece jen v každém případě se zde jedná o rostlinné zbytky takového rázu, jaký se objevuje v pozdní křídě nebo začátkem paleogenu. Bohužel v celé kolekci nejsou vůbec zastoupeny žádné opravdu význačnější prvky společnosti *Platanus-Aralia*, která je tak charakteristická pro křídové období, ani žádné výrazné typy *dryophylloide* tak hojně a příznačně pro ranný paleogen. Zjištěné druhy nám tedy nemožno dát jasnou a definitivní odpověď, zda hrutovské pískys pocházejí z pozdní křídly nebo již z paleogenu; napovídají nám jen, že patří někam do časového rozmezí senon — starší paleogen. Rozhodně však vylučují zde stáří neogenní. Ale i tento výsledek, vzhledem k omezenému počtu exemplářů i jejich dosti nepříznivému způsobu zachování, třeba považovati za jistý pokrok v našem poznání fosilních květen jihočeské pánve.

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ABSTRACT:

This paper presents a palaeobotanical analysis of the plant impressions which have been collected in the iron stones of the sandy series at Hrutov (near the village of Lišov between Č. Budějovice and Třeboň in S. Bohemia) and which are conserved in the collections of the geological and palaeontological dep. of the Nat. Museum, Prague. The sandy series containing the just named iron stones was until not long ago regarded as of Neogene (mostly Miocene) age, just as nearly all other sediments of the South Bohemian basin. A thorough study of the plant remains from these iron stones showed, that they belong to a considerably older period. Besides several at present nearer undeterminable specimens, to which in the following the non-committal generic term of *Dicotylophyllum* is applied, there have been recognised these peculiar plant types: *Sequoites primaeva* (C d a.) Reuss, *Pityophyllum* sp. (rather long and big needles), *Myricophyllum zenkeri* E t t. sp., *Myricophyllum serratum* V e l. sp., *Dewalquea insignis* H o s. et v. d. M., *Dewalquea haldemiana* H o s. et v. d. M., *Alniphyllum kefersteini* U n g. sp. (see in E. B a y e r 1896). No doubt we have to do here with plant types, which are to be met in various plant associations of the late Cretaceous or oldest Tertiary. But in this collection the most typical elements of the late Cretaceous *Platanus-Aralia* association are missing. I did not find here even any specimen of the very characteristic Paleogene *dryophylloid* types. Meanwhile we are unable therefore to resolve, whether we have here to do with a late Cretaceous or already an old Palaeocene flora. It is however certain that the sandy series of Hrutov

cannot be correlated with any Neogene series; they are to be assigned somewhere into the time space Senon-Palaeocene i. e. as already mentioned in my preliminary report from 1956, to the lowest division (Zliv—Gmünd series) of the whole rock system of the South Bohemian basin.

PREFACE

The main part of the rock system of the South Bohemian basin was on account of Ettingshausen's and Reininger's researches regarded until not long ago as a very big Miocene series. In 1938 I have published two short notes about several casts of plant impressions from the fireclays of Klikov (near Suchdol), which indicated a considerably greater geological age. Similar discoveries were made later also in the fireclays of Zliv (in the forestry "Blana"; N.W. of Budějovice). Consequently I undertook during the past ten years many researches in the various regions of the South Bohemian basin during which I amassed also many plant fossils, which especially in the older beds are here rather rare. After a preliminary thorough comparison of the various found plant associations, I went finally to the conviction that the deeper horizons of this basin are essentially older than the higher ones, containing the well known diatoms and lignites (F. Němec 1956). Because on account of the extreme rarity of animal remains the fossil flora is at the mean time the unique factor, which enables us to define directly at least in coarse limits the stratigraphical correlations of the various strata in this basin, I regard as very useful and important to present detailed palaeobotanical descriptions and taxonomical analysis of the various fossil floras, which were found hitherto at different places or stratigraphical horizons in this basin. My preliminary rough scheme of the stratigraphy of the whole rock system, the chief part of which I have divided into two main series (the older Zliv-Gmünd series of an Upper Cretaceous till a Lower Palaeogene age, and the younger Mydlovary-Borovany series of Neogene age [F. Němec 1956]) will be by this way well documented and eventually also improved. The present paper is the first study of this series of monographs, which I have intention to publish during the next years about the fossil floras of the South Bohemian basin.

During all my palaeobotanical studies and various field researches I was supported by many of my friends geologists as well as palaeontologists. I am especially much indebted to Dr. B. L. Pacltová, who is studying at present palynological problems concerning various deposits in the same basin, further to Dr. G. Mrázek who is here engaged in the geological investigations and mapping works, and finally to Doc. Dr. Z. d. Špinar who is performing here various special stratigraphical researches and discovered already several till present unknown fossiliferous localities. Together with these friends I spent also many agreeable and very useful moments in the various regions of Southern Bohemia.

I. Introduction.

Hrutov is a small hamlet situated about 3 km N. of the village of Lišov (between Č. Budějovice and Třeboň). In its nearest surroundings only a big series of yellowish sands and sandy gravels may be observed, which locally

contain thin and insignificant clayish interlayers and which evidently cover here the old crystalline rocks, mostly gneisses. These old underlying rocks are exposed here at many places along the small brook flowing down from Velechvín (W.N.W. of Hrutov) across Levín (S. of Hrutov; between Hrutov and Lišov) and Hůrky (E.S.E. of Hrutov) to the region of the great ponds between Třeboň and Lomnice. We may well observe them for instance in the outcrops at the road between Levín and Hrutov in the mentioned valley, further at the western rand of the hamlet of Hůrky in a quarry at the road to Hrutov and finally about 300 m southward from Velechvín in a deep quarry (at the road to Jílmo and Libnič), where they contain also crystalline limestones. The overlying series of sands and gravels contains here at many places not very deep under the surface a horizon rich in iron stones and concretions, mostly of flat and irregular shape, which locally are forming a more or less coherent and rather big bank. And just these iron stones in the past, perhaps some 100 years ago, were mined in the fields westward and north-westward from Hrutov and carried as a rather suitable iron ore to the various small iron works in the region of Třeboň and Suchdol, which all have already long ago ceased to exist. Locally these iron stones contain impressions of many plant remains. But well preserved impressions of whole determinable leaves are here rather rare. At my field investigations I collected here very often imprints of smaller plant fragments especially of fragments of various twigs or of bigger stems, but till now no perfectly preserved leaves or fruits. A small collection of somewhat better preserved fossils from this place are conserved in the geological and palaeontological department of the National Museum, Prague. I am very indebted to Dr. V. I. Z á z v o r k a, the head of this museal department, and to Mrs. A. Ž e r t o v á for the kindness which enabled me to borrow this material for a thorough examination. All specimens of this collection were obtained many years ago by Dr. F. Z i p p e and were only superficially examined by Dr. A. F r i č and Dr. J. V e l e n o v s k ý, but no more detailed analysis of them were ever published. As evident from the labels joined to the single specimens, these investigators regarded most of these Hrutov leave impressions as species of the genera *Salix* and *Andromeda*. Consequently only a Tertiary age was ascribed to the whole Hrutov sandy and gravel series. But a very careful examination of this collection, which I newly undertook, showed that it contains quite different types, than as assumed by the mentioned scientists, which led me also to another biostratigraphical correlation of the whole Hrutov sandy series. I recognised here a plant association containing several elements common with the Upper Cretaceous floras (Senonian-Danian) of western Europe, especially those of the region of Aachen and Maestricht (F. N ě m e j c 1956), as will be obvious from the following descriptions of several species verified in this old collection.

II. Description of the species.

Gymnospermae.

This plantgroup is represented in our collection only by two rather inadequate types: some needle like leaves of the type *Pityophyllum* and a

small fragment of a twig of the type of *Sequoites primaeva* (C d a.) Re u s s. No cones nor any seeds are associated to them.

Pityophyllum sp. (Pl. X, fig. 2, 2a). — Several detached and partially broken needle like leaves resembling those of the genus *Pinus* are well visible on the figured specimen. But no dwarf shoots betraying safely their real affinity with that genus are preserved, and even none of the preserved needles is whole; all are broken at both ends. According to the single fragments they were certainly more than 8 cm long and about $1\frac{1}{3}$ mm wide and marked by a very strong longitudinal median keellike line.

It is clearly impossible to refer such fragmentary preserved needle impressions to a definite specific coniferous type. They bear a close resemblance to some very big *Pinus* leaves. Among the various types of needles published hitherto from the Cretaceous as *Pinus* leaves, the most similar are those figured newly by F. Stockmans (1946, pp. 20, Pl. II, fig. 3) from the Upper Cretaceous Asize des Sables d'Aix-la-Chapelle (Aachen) at Eisden. They exhibit nearly the same dimensions as well as similarly sharply marked longitudinal median keellike line.

Sequoites primaeva (Corda) Reuss (Pl. X, fig. 1, 1a and Text fig. 1). — With this rather artificial species I compare a very small fragment of a sterile leafy twig (perhaps top of a twig), about 1.5 cm long. Its leaves are 5-6 mm long, spirally disposed, crowded and distinctly sharply falcate like in the recent genus of *Cryptomeria*.

From the late Mesozoic or older Kainozoic periods we know a considerably large series of coniferous types bearing similar leafy twigs like this small fragment from Hrutov. Mostly they are of Taxodiaceous affinity (*Elatocladus*, *Geinitzia*, *Ceratostrobis*, "*Araucarites*", "*Sequoites*" a. o.). Most similar in all respects to our small fragment seems to be Corda's *Sequoites primaevus* (originally described as *Cryptomeria*; Corda 1845 in Reuss), which was also newly described and figured from the Upper Cretaceous of Belgium by F. Stockmans (1946), who presents also very thorough taxonomical analysis of this species. It was originally described from the Bohemian Cretaceous (Cenomanian) and later very often confused with another much bigger type known as *Sequoia* or *Elatocladus reichenbachii* Gein. sp. from the Saxonian Cretaceous; this last exhibits leaves nearly 3 till 4 times longer than in our Hrutov specimen. Under the name of *S. reichenbachii* Gein. it was also described in 1890 by T. Lange (pp. 660, T. 32, fig. 1-8) from the Upper Cretaceous of the region of Aachen; several of his specimens show a striking similarity with our fragment from Hrutov. Another coniferous type, which bears also some similarity with our specimen is the well known palaeogene species of *Elatocladus* (*Araucarites*) *sternbergii* (Goepf.) Mar. But here the leaves according to the descriptions of various palaeobotanists dealing with the Eocene floras (see e. g. C. v. Ettingshausen 1853, pp. 36, Pl. 7, fig. 1-10, Pl. 8, fig. 1-12; C. v. Ettingshausen 1855 [Hering]; P. Friedrich 1883 [under the name of *Sequoia couttsiae* Heer]; E. Fischer 1950; K. Rásky 1941) are not sharply falcate, but rather S-like bent. Therefore I prefer to iden-



Fig. 1. *Sequoites primaeva* (C d a.) Reuss. 2X.

tify our Hrutov fragment with the mentioned Lange's or Stockman's type.

Angiospermae.

From this plant group only leaf impressions of rather obscure affinity were stated. Therefore I do not adopt for them the generally used generic names current at the description of various Tertiary floras. In cases, where already some hypothetical relations to several recent genera were pointed out by our prominent palaeobotanists (J. Velenovský, E. Bayer, L. Viniklář a. o.), I am adopting here names composed of the generic name of the respective recent plant genus, selected already by older authors for comparison with the fossil specimens, and of the ending *-phyllum* (e. g. *Alniphyllum*, *Myricophyllum* a. o.). In other cases, where till now no such comparative attempts were made or where such comparisons are hardly possible, I am adopting special generic names current at the description of various Cretaceous or older Tertiary plants of obscure affinity (e. g. *Dewalquea*, *Macclintockia* a. o.) or the noncommittal name of *Dicotylophyllum*. This practice, which is adopted in the most of the recent monographical works dealing with the various Cretaceous or older Tertiary floras, seems to be much more suitable at the analysis of such older plant assemblages, than the older methods using directly the generic names of some similar recent plants. We obtain by this way a picture of the sociological, palaeogeographical as well as ecological conditions which is not as misleading as that obtained on the basis of lists of names relating directly with plantgenera living still at present; only enough precisely defined species or at least genera can reveal per analogiam with the respective recent types something reliable as to such problems.

In the whole I stated about 7 different angiospermous, chiefly dicotyledonous leaf types or "species" in the named museal collection of fossils from Hrutov:

Myricophyllum zenkeri Ett. sp.

Myricophyllum serratum Vel. sp.

Alniphyllum kefersteinii E. Bayer sp. 1896. (-*Alnus kefersteinii* Ung.)

Dewalquea insignis Hos. et v. d. M.

Dewalquea haldemiana Hos. et v. d. M.

Dicotylophyllum cf. *pfaffianum* Heer sp. (-*Andromeda pfaffiana*)

Dicotylophyllum iliciforme n. sp. (aff. *Ilex perneri* E. Bayer 1893 ?).

Dicotylophyllum lauriforme n. sp.

All these determinations bear many imperfections and even serious objections can be eventually brought against them. But the fragmentary and defective material at disposal does not allow any more detailed or more reliable results. There is nearly no whole leaf among the available impressions and moreover the nervation is mostly very obscurely preserved, which renders all determinations and comparative studies extremely difficult. Therefore the whole Hrutov collection of leaf impressions, though very important as to the local geological conditions and partly perhaps also from the point of view of the palaeogeography, cannot be well used for any ecological study.

Myricophyllum zenkeri Ett. sp. (Pl. XI, fig. 1-3, 3a, 3b and Text fig. 2).

— With this species I compare three leaves about 7-11 cm long and 1.2-1.7

cm broad, of an oblong lanceolate shape. They are provided by a very strong and straight midrib. At the base their lamina tapers slowly into a strong petiole. Their margin is in the basal part entire, otherwise rather coarsely serrate, its teeth being upwards curved. The whole leafblade is broadest in its middle part tapering slowly to the base as well as to the top. The nervation is very obscure; only several secondary veins are slightly visible. They are given off at an angle of about 50° and are in a considerable distance from the margin curved upwards. Between two neighbouring secondary veins often still one additional incomplete vein occurs.

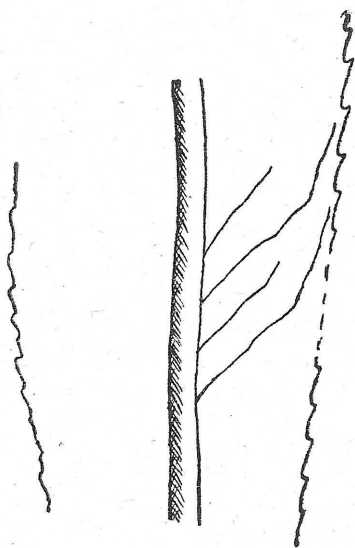


Fig. 2. *Myricophyllum zenkeri*
Ett. sp. $\times 2\frac{3}{4}$.

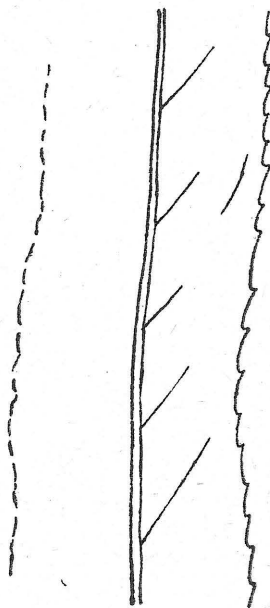


Fig. 3. *Myricophyllum*
serratum Vel. sp.
 $\times 2\frac{3}{4}$.

Our figured specimens may be compared with smaller and narrower forms of *Myr. zenkeri* Ett. sp. as described and figured by J. Velenovský 1881-1885, pt. II, pp. 13, Pl. III [XI], fig. 1-9, especially with his fig. 2, 5 and 9. But there are still other Cretaceous leaf types which bear some similarity with our Hrutov specimens, e. g. *Myricophyllum denticulatum* Vel. et Vin. (1926-1931, pt. IV, pp. 17, Pl. XXX, fig. 8-11) differing from true *M. zenkeri* Ett. by another kind of margin denticulation, further *Myrica cretacea* Heer (1871), *Myrica hollicki* Ward (in Hollick 1906) and finally also several types mentioned by various authors under the generic name of *Celastrophyllum*: *C. benedeni* Sap. et Mar. (1873, pp. 67, Pl. X, fig. 6; Pl. XII, fig. 1, 2), *C. lanceolatum* Ett. in Sap. et Mar. (1873, pp. 68, Pl. XII, fig. 3), *C. serratum* Sap. et Mar. (1877, pp. 87, Pl. XIV, fig. 3) and *C. grandifolium* Newb. in Newb. - Hollick (1895). Among all these forms a rather close similarity may be stated in Saporta and

Marion's *Celastrophyllum lanceolatum* Ett. But the defective state of preservation of our Hrutov specimens does not allow an absolutely safe identification. Nevertheless I believe that our Hrutov specimens bear most similarity with smaller specimens of *M. zenkeri* Ett.

M. zenkeri Ett. sp. was first described by C. v. Ettingshausen (1867) as *Dryandroides zenkeri* from the Cretaceous of Niederschöna in Saxony. Its complete synonymy is to be found in A. Frič and E. Bayer's work from 1901 (pp. 113; see also notes in F. Stockman's 1946, pp. 31). It is a very common type in the Cenomanian beds (the series of Peruc) of the Cretaceous of Bohemia, but till present it was not yet cited either from the Turonian beds or from the Emscher stage of this land. On the other hand it is mentioned from the younger phase of the Upper Cretaceous (Senonian-Danian) in western Europe (from the region of Aachen and Maestricht) by F. Stockmans (1946, pp. 31-33, Pl. 4, fig. 2). It seems therefore that this type (or very similar leafforms) can be followed through the whole European Upper Cretaceous.

Myricophyllum serratum Vel. sp. (Pl. XII, fig. 4b, Pl. XIII, fig. 1 and Text fig. 3). — This species was first described by J. Velenovský in 1881-1885 (II pt., pp. 9, Pl. II, fig. 1-8). Compared with the foregoing type it exhibits much narrower and rather elongated leaves with nearly parallel and rather straight margins in the middle part of the blade, which at the base and at the top is tapering very slowly. The margin is said by Velenovský to be serrate but preserved by much smaller and rather remote teeth (with very shallow incisions) than in *M. zenkeri* Ett. The course of the secondary veins are described as rather similar to that in *M. zenkeri* Ett. J. Velenovský mentions that they are given off at a nearly right angle being than arclike curved upwards. But in his own figures (as well as in various specimens conserved from the Bohemian Cretaceous in the collections of the Nat. Museum, Prague) the angle which they make with the midrib is about 60° till only 40° (see e. g. his fig. 4 and 8a on Pl. II).

The only one specimen from Hrutov which with some hesitation I identify with this Velenovský's species, is unfortunately only fragmentary; its top and base are not preserved and the nervation is very obscure. The strongly marked midrib, the considerably parallel margins, their kind of denticulation as well as the size of the whole impression (it is about 9 mm broad) are quite in agreement not only with Velenovský's figured specimens, but also with various specimens conserved in the collections of the National Museum, Prague. Of the secondary veins only their basal parts are visible in the Hrutov fragment; tertiary veinlets are totally missing here. The angle made with the midrib by the secondary veins is rather narrow, still less than 45°, which is the only slight difference which may be pointed out between our Hrutov fragment and the majority of the *M. serrata* specimens known from the Bohemian Cretaceous. We may thus regard this identification as very probable but not as without any possible objections.

Alniphyllum kefersteinii Ung. in E. Bayer 1896 (as *Alnus kefersteinii* Ung.). — The small fragment, figured on Pl. X, fig. 3, 3a and Text fig. 4, represents basal part of a most probably ovate leaf with a very strong and rather straight midrib. On both sides of the midrib 3 secondary veins in

an alternating order are given off at an angle of 55° till 60° which in their middle and especially terminal portions are arclike bent upwards. The tertiary veins are mostly at nearly right angles to the secondaries; between them further finer reticulum is partly visible. At the very base of the midrib on its right side an imperfect rather thin secondary vein may be observed.

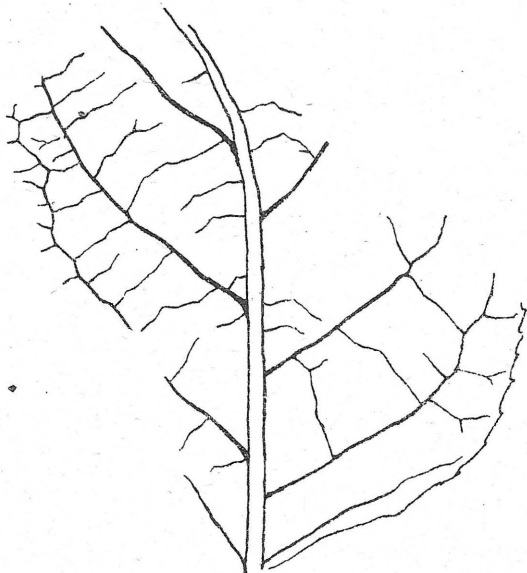


Fig. 4. *Alniphyllum kefersteinii* E. Bayer
sp. 1896. $\times 3$.

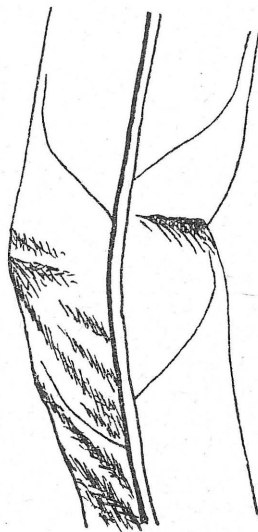


Fig. 6. *Dewalquea* cf. *haldemiana* Hos. et v. d. Marck.
 $\times 2\frac{1}{3}$.

ved. At the base of this fragment also a small part of the leaf margin is preserved; its lowest portion is quite entire, further up it is distinctly serrate.

The arclike anastomosing of the endportions of the secondary veins, the course of the secondary as well as of the tertiary veins, the presence of short and rather thin basal imperfect secondary veins running a small distance along the margin and finally also the kind of denticulation of the margin correspond well with leaves of various species of the genus *Alnus*. Our fragment is hardly distinguishable from the very common Tertiary form of *Alnus kefersteinii* U n g. Very similar leaves were mentioned from the Bohemian Cretaceous already by E. Bayer (1896, pp. 9 [33], Fig. 10) in the Emscher stage (the series of Chlomek) directly under the name of *Alnus kefersteinii* U n g.

Our fragment bears at first sight also some similarity with several other leaves described from the Upper Cretaceous in various foreign countries not only as *Alnus* leaves but also as the leaves of several *Quercus* species. We have to mention especially *Quercus paucinervis* Hosius 1869 (1867-1870, pp. 98, Pl. 13, fig. 12) or *Quercus euryphylla* Hos. et v. d. M. 1880 (Pl. 28, fig. 48-50, Pl. 29, fig. 51) of the Aachen region. But the fea-

tures of the nervation as pointed out seems to support much more the assumption of an *Alnus* nature of our fragment than of that of *Quercus*. I believe therefore that we have here to do with leaves of the same (or at least very similar) nature as those described by E. Bayer from the Emscher stage of the Bohemian Cretaceous. In older Cretaceous series of Bohemia (Turonian or Cenomanian) this type of leaves was not yet stated.

Dewalquea insignis Hos. et v. d. M. (Pl. XII, fig. 1, 2; Pl. XIII, fig. 2-5 and Textfig. 5). — Leaf impressions to which I adopt this name are most frequent of all among the available fossils from Hrutov. But all represents only isolated leaflets. They are narrow lanceolate, about more than 1 dm long and till 1.5 cm broad, tapering very slowly in an often very strongly asymmetrical base and a rather long and narrow top. Their midrib is very strong; otherwise the nervation is mostly almost totally obscure. Only in some rare specimens at some places the secondary veins are slightly preserved. These are rather straight and are given off from the midrib at an angle of about 45° . In a very short distance from the margin they are joining to a nearly equally strong veinlet which is running conformally along the whole margin. The leaf margin in the basal portion of the leaves is entire or only slightly undulated, further up until to the top it is preserved by widely separated (about $\frac{2}{3}$ cm or even more), low and characteristically upwards turned teeth.

These Hrutov specimens exhibit no doubt most similarity with isolated leaflets of *Dewalquea insignis* Hos. et v. d. M. as already told (see in Hosius and v. d. Marck 1880, Pl. 32, fig. 111-113, Pl. 33, fig. 109, Pl. 34, fig. 110, Pl. 35, fig. 123), especially with narrower leaflets of this species (see especially Hos. et v. d. M. Pl. 35, fig. 123). At the first sight considerably similar are also leaflets of *Dewalquea aquisgramensis* Sap. et Mar. (1873; see also in F. Stockmans 1946 and T. Lange 1890), with which I have previously (see F. Němec 1956) compared these Hrutov fragments. But in this second type the secondary veins make a much more acute angle with the midrib. Further similar leaflets are to be observed also in *Dewalquea lusitanica* Teix., which occurs very frequently in certain fireclay beds of the region of Křivá (S. of Třebon). But here the leaflets are considerably shorter, measuring only 5 till 7 cm in length.

Dew. insignis Hos. et v. d. M. is a rather frequent type of the uppermost Cretaceous of western Europe, being especially well known from the regions of Aachen and Maestricht. From the Cretaceous of northern and central Bohemia, which corresponds with the middle phase of this period (Cenomanian, Turonian and Emscherian) it is not yet known.

Dewalquea cf. *haldemiana* Hos. et v. d. M. (Pl. XII, fig. 3 and Textfig. 6). — Among the Hrutov specimens I found also a small fragment which at the first sight is rather similar to the foregoing type. But it is provided by wholly entire margins. The finer nervation is even here almost quite missing. The midrib is rather strong and the partially visible secondary veins exhibit a very similar course as in the foregoing type, being given off from the midrib at an angle of about 45° (or even slightly more).

Previously (see F. Němec 1946) I compared this fragment with *Dewalquea gelindensis* Sap. et Mar. But in this form the secondaries are given off from the midrib at much more acute angles than in our Hrutov

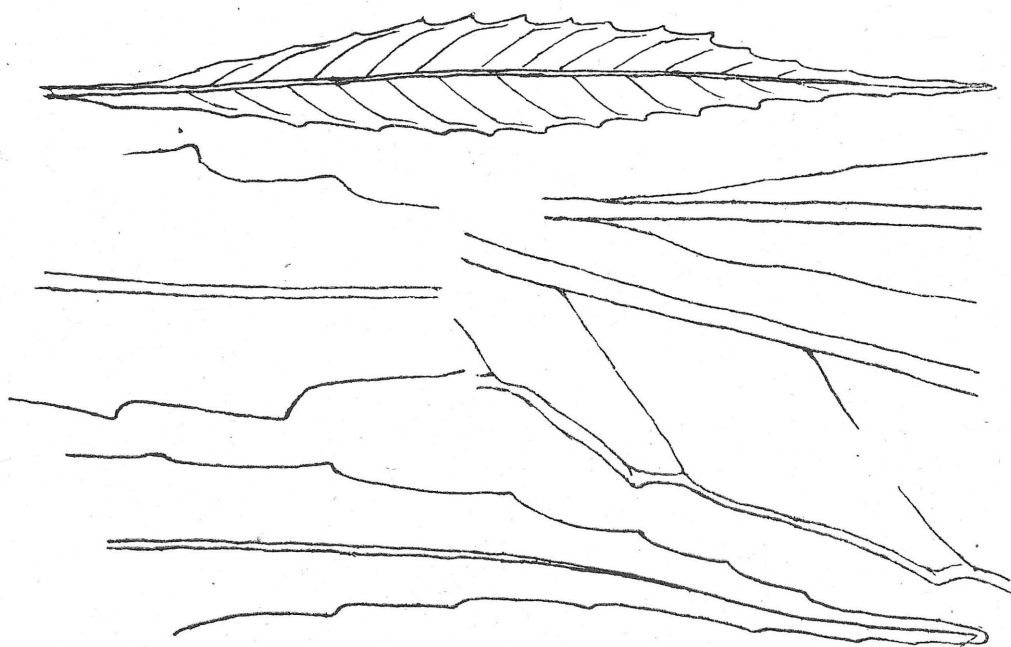


Fig. 5. *Dewalquea insignis* H o s. et v. d. M a r c k. — Reconstruction of a leaflet (nat. size and various parts of the leaf fragments (X3).

specimen. In this respect much more similarity exhibit leaflets of the named *Dew. haldemiana* H o s. et v. d. M a r c k, where the angle made by the secondaries and the midrib are nearly equally wide as in our fragment. Of course from the Upper Cretaceous and Lower Tertiary we know a great deal of various other similar oblong lanceolate leaves with entire margin, wherefore our designation of this Hrutov fragment must be regarded as indeed rather probable but far from a quite safe identification.

Dewalquea haldemiana H o s. et v. d. M. like the foregoing species is a characteristic element of the Upper Cretaceous (Senonian) flora of western Europe, especially of the Aachen and Maestricht regions.

Dicotylophyllum cf. *pfaffianum* H e e r sp. (Pl. XII, fig. 4a, 5 and Text-fig. 7). — On a slab bearing the already described impression of *Myricophyllum serratum* V e l. small imprint of a fragment of another also very characteristic leaf is present. The preserved portion is about 7-8 mm broad; its base and top is broken off. The shape of this leaf, judging according to the slightly arclike formed margins, was no doubt lanceolate, tapering slowly to the top as well as to the base. Its total length was over 3 cm. The margin is entire. The finer nervation is not visible; only the rather strong midrib and the secondary veins are preserved. The secondaries are given off from the straight midrib at very steep angles (about 20°), they are slowly arclike bent upwards and when reaching nearly the margin, they are running a considerable distance along it in the direction to the end portion of the next higher neighbouring vein. But the mode of an eventual mutual joining of the single end portions of the secondary

veins is not observable in our fragment. Lanceolate or ovato lanceolate leaves with entire margin and rather steep, arclike bent secondary nervation appear in various families, especially in the families *Lauraceae*, *Rhamnaceae*, *Cornaceae*, *Rubiaceae*, *Ericaceae* a. o. With regard to the shape of our leaf fragment especially several fossils assigned generally to the genera *Nectandra* (*Lauraceae*) and *Andromeda* (*Ericaceae*) from the Tertiary or Cretaceous floras bear most similarity with it. We have to point especially to certain leaves described by O. Heer from the Kome series of Greenland as *Andromeda pfaffiana* (O. Heer 1882, Pl. 25, fig. 6 and Pl. 38, fig. 5, 6, 7). Especially Heer's figures Pl. 38, fig. 6 and 7 exhibit a very close resemblance with our fragment. But because on this fragment no details concerning the finer venation are visible, I hesitate to assign it to any definite recent genus. For the close resemblance to Heer's *Andromeda pfaffiana*, I make use just of this specific name being well aware that we have here to do only with a wholly external similarity which has nothing in common with any real affinity.

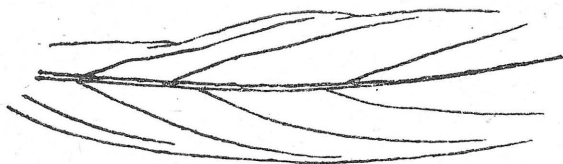


Fig. 7. *Dicotylophyllum* cf. *pfaffianum* Heer. $\times 24/5$.

Dicotylophyllum iliciforme n. sp. — The specimen figured on Pl. XII, fig. 6 represents fragment of an ovato lanceolate leaf over 4 cm long and about $1\frac{3}{4}$ cm broad. The top of it is broken off. Its base is cuneate and provided by a short (cca. 6 mm) petiole. The margin is entire, the midrib rather strong and straight. Secondary veins are very indistinctly marked; they are straight or slightly arclike bent and reach almost the margin being here slightly curved upwards. Nothing is preserved of its finer venation. The whole leaf according to the outline of its preserved portion was perhaps widest above its middle part.

On account of the unfavourable state of preservation and because only one unique fragment of that kind is available, it is quite impossible to assign this impression to any definite plant type. It bears some similarity with E. Bayer's *Ilex perneri* from the Turonian flora (series of Březno) of Bohemia (see E. Bayer 1893, pp. 20 [42], fig. 14). To express this only external similarity but not any true identity I used here the noncommittal specific term of "iliciforme".

Dicotylophyllum lauriforme n. sp. — On Pl. XII, fig. 7 I figure another leaf impression, which I am unable to assign with confidence to any hitherto known type. It is of a lanceolate shape, contracted vedgelike at the base into a short petiole and broadest a little below its middle part. Its very top is broken off, the margin is entire. The nervation is very indistinctly preserved. There is a strong and straight midrib giving off at angles of about 30° till 40° alternating and indistinctly visible, arclike upwards curved

secondary veins. Tertiary veins or the finer reticulation are not preserved.

As to the secondary nervation this fragment exhibits some similarity to the several *Laurus* species described by J. Velenovský from the Bohemian Cretaceous (*Laurus plutonia* Heer from the Cenomanian series and *Laurus affinis* Vel. from the Emscherian stage; see J. Velenovský 1881-1885, pt. III, pp. 1, Pl. IV, fig. 2-4; pt. IV, pp. 9, Pl. V, fig. 4, 5, 7, 8). But the base of the leaf blade of our fragment is slightly different, considerably narrower wedge-shaped. Also in other plant families similarly formed secondary venation in combination with similar lanceolate shape of the leafblade are often to be found e. g. *Bombacaceae*, *Thymelaeaceae*, *Combretaceae*, *Cornaceae*, *Rubiaceae*, *Oleaceae*, *Rhamnaceae* a. o. All features perceptible on our specimen certainly do not suffice to any real closer comparison with any recent or fossil type. To express at least the mentioned external similarity with many lauroid leaves I adopt to it like in both preceding cases only a noncommittal name, that of *Dicotylophyllum lauriforme*.

III. Conclusion

The available material of fossils from Hrutov is too meagre and the single specimens too inconveniently and too fragmentary preserved (only mere impressions without any epidermis strips conserved), to serve as a satisfactory basis of a reliable recognition of the plant species comprised therein. Only the coniferous remains identified here as *Pityophyllum* sp. and *Sequoites primaeva* (C d a) Reuss point to some more definite affinities; the first one to the genus of *Pinus*, the second one at least to the family of the *Taxodiaceae*, perhaps to some plants assigned generally by the generic name *Elatocladus* or to several taxodioid genera like *Sequoia*, "*Araucarites*", *Ceratostrobis* a. o. But they do not reveal anything essential of the ecological character of the whole plant assemblage or of the climatical conditions by which this flora was effected. The presence of specimens described here as *Myricophyllum* or *Dewalquea*, which represent only mere dicotyledonous formgenera without any at present trustworthy proved affinity with any living angiospermous plant genus, equally cannot be regarded as any serious indicator of the ecological or climatical conditions. Besides we have to state that even the determination of the leaf fragments assigned here to the formgenus of *Dewalquea* is not free from any possible claim; there are in the available material only isolated leaflets, wherefore we have no direct proof whether in reality the whole leaves in our case were composed of 3 or 5 such leaflets, like in the true *Dewalquea* species. Also in the case of the small fragment, which I have compared with *Alnus kefersteinii* Ung., no absolutely satisfactory evidence of its real affinity to that type could be obtained. I adopted here therefore only the generic name *Alniphyllum* to express its similarity to the leaves of *Alnus*, but not any true affinity. Finally specimens for which only the noncommittal generic name of *Dicotylophyllum* was adopted, are utterly useless for any climatological or ecological deductions, because in such cases we have absolutely no notion as to their natural affinities.

The taxonomical estimation of the described Hrutov specimens meet evidently with extreme difficulties. This is the reason why we are utterly

unable to take up any definite point of view either to the ecological character of the Hrutov flora or to the climatical conditions under which this plant assemblage flourished.

Nevertheless comparing the general external appearance of the various ascertained leaf forms with those known hitherto from different divisions of the late Cretaceous or Tertiary periods, we may draw at least several important consequences concerning the geological age of the sandy series of Hrutov from which the fossiliferous iron stones were obtained. Of course the relatively small number of plant species stated in the just described material makes here some difficulties. Several of the found species bear so close a resemblance to various leafforms known hitherto from different stages of the late Cretaceous and Tertiary, that it is rather difficult to use them directly as indices of the respective geological age. We have therefore to take in consideration also several general features relating to the composition of the whole Hrutov leaf assemblage, which may reveal also several more definite facts concerning this task, which from the point of view of the general stratigraphy of the sediments of the Třeboň basin is no doubt of a fundamental importance.

The *Dewalquea* type of leaves is mostly common in the younger phase of the Cretaceous, several species already in the Cenomanian, most of the known species in the Senonian and Danian; they reach even perhaps into the oldest Tertiary periods (Palaeocene). In the middle or later phases of the Tertiary this type is missing, at least in the European countries. The same may be said also about our species of the formgenus of *Myricophyllum*, though true representants of the genus *Myrica* are very abundant nearly in all older and middle phases of the Tertiary (especially in the Upper Oligocene and Lower Miocene). Our *Myricophylla* from Hrutov represent an utterly different type of leaves, which hardly could be regarded as nearer related with the true *Myrica* forms of the Tertiary. As mentioned in the previous descriptions, our *Myricophylla* from Hrutov point best to several leaf forms described as *Myrica* (or *Dryandroides*) by various authors from different stages of the Upper Cretaceous (already up from the Cenomanian). But several more or less similar types under different generic names (*Myricophyllum*, *Celastrophyllum*, *Dryandroides*) are mentioned not only from the uppermost Cretaceous but also from several Lower Tertiary floras, though mostly not as specifically predominating plant elements. Leafforms described here as *Alniphyllum* or mentioned here as indeterminate fragments under the noncommittal generic name of *Dicotylophyllum* are utterly indecisive, because such types or closely similar forms are to be followed throughout the whole time space of the Upper Cretaceous and Tertiary until to the present time. As to both coniferous remains, the needlelike leaf type of *Pityophyllum* is to be regarded also as rather indecisive being represented by various species (eventually as remains of the genus *Pinus*) already up from the Jurassic, throughout the whole Cretaceous and Tertiary until to recent times, in the European regions most abundantly in the Upper Cretaceous (Senonian, Danian) and Tertiary. A little more decisive seems to be our *Sequoites* fragment. Such or very similar leafy twigs are mostly to be found in the Cretaceous and older Tertiary stages.

All these though rather meagre facts make very probable that the geological age of the Hrutov fossil plant assemblage is to be estimated as uppermost Cretaceous (Senonian-Danian) till Lower Palaeogene. This opinion is especially supported by the simultaneous abundant occurrence of the *Dewalquea* and *Myricophyllum* types with the coniferous remains of the rather big *Pityophylla* and *Sequoites* twigs as well as several leafforms reminding elements of the younger Tertiary (our *Alniphyllum* and the various "*Dicotylophylla*"). There is especially a very close resemblance between our Hrutov plant assemblage and several West-European Upper Cretaceous ev. Lower Palaeogene floras e. g. the floras of the classical regions of Aachen, Maestricht, Gelinden a. o. (see in the works by Hosius, v. d. Marck, Saporta and Marion, Lang, Stockmans a. o.). But the relatively small number of plant species stated here in the iron stones of Hrutov does not allow a more precise determination of the stratigraphical stage, i. e. whether we have to do here with an Upper Cretaceous series or already a Palaeocene one. I have not found in our Hrutov collection of fossils any *Platanus* or *Credneria* types as well as any of the very characteristic Cretaceous *Aralia* species, which both represent nearly the "Leitfossilien" of the Cretaceous period. But at the other hand I did not find here also any typical *Dryophyllum* species which in association with several more "modern" types represent the most remarkable component of the older Palaeogene (especially Palaeocene) floras. Therefore we have to conclude this discussion only with an approximative statement, that the time space to which the Hrutov sandstone series containing the well known iron stones may be assigned, is the period beginning with the Senonian and reaching into the older Palaeogene. This is perhaps also the most interesting and most important fact, which emerges from a detailed taxonomical revision of the plant fossils from the Hrutov iron stones, because until to the very recent time, as already mentioned in the preface, nearly all sediments of the South Bohemian basin were regarded as of Miocene or even younger age.

EXPLANATION OF PLATES

Plate X.

- Fig. 1. *Sequoites primaeva* (Corda) Reuss. Nat. size.
 Fig. 1a. *Sequoites primaeva* (Corda) Reuss. $\times 2$.
 Fig. 2. *Pityophyllum* sp. Nat. size.
 Fig. 2a. *Pityophyllum* sp. $\times 2\frac{4}{5}$.
 Fig. 3. *Alniphyllum kefersteinii* E. Bayer sp. 1896. Nat. size.
 Fig. 3a. *Alniphyllum kefersteinii* E. Bayer sp. 1896. $\times 3$.

Plate XI.

- Fig. 1, 2 and 3. *Myricophyllum zenkeri* Ett. sp. Nat. size.
 Fig. 3a. and 3b. *Myricophyllum zenkeri* Ett. $\times 2\frac{3}{4}$.

Plate XII.

- Fig. 1 and 2. *Dewalquea insignis* Hos. et v. d. M. Nat. size.
 Fig. 3. *Dewalquea haldemiana* Hos. et v. d. M. Nat. size.
 Fig. 4. *Myricophyllum serratum* Vel. sp. (at b) and *Dicotylophyllum* cf. *pfaffianum* Heer (at a). Nat. size.
 Fig. 5. *Dicotylophyllum* cf. *pfaffianum* Heer. $\times 2\frac{4}{5}$.
 Fig. 6. *Dicotylophyllum iliciforme* n. sp. Nat. size.
 Fig. 7. *Dicotylophyllum lauriforme* n. sp. Nat. size.

Plate XIII.

- Fig. 1. *Myricophyllum serratum* Vel. sp. $\times 2\frac{3}{4}$.
 Fig. 2—5. *Dewalquea insignis* Hos. et v. d. M. (-parts of the leaves figured on Pl. 3, fig. 1 and 2). $\times 3$.

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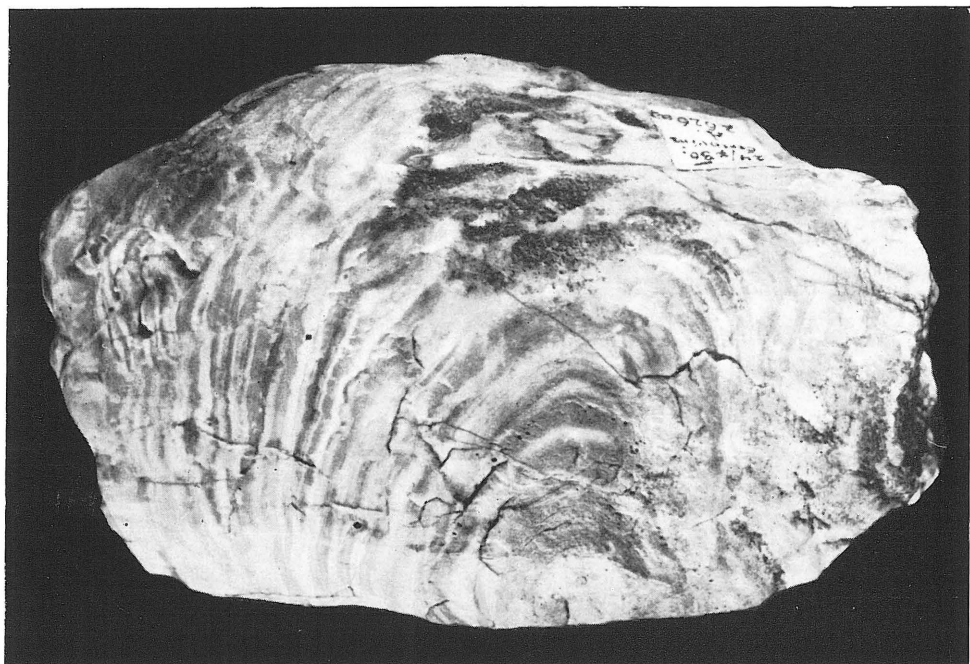
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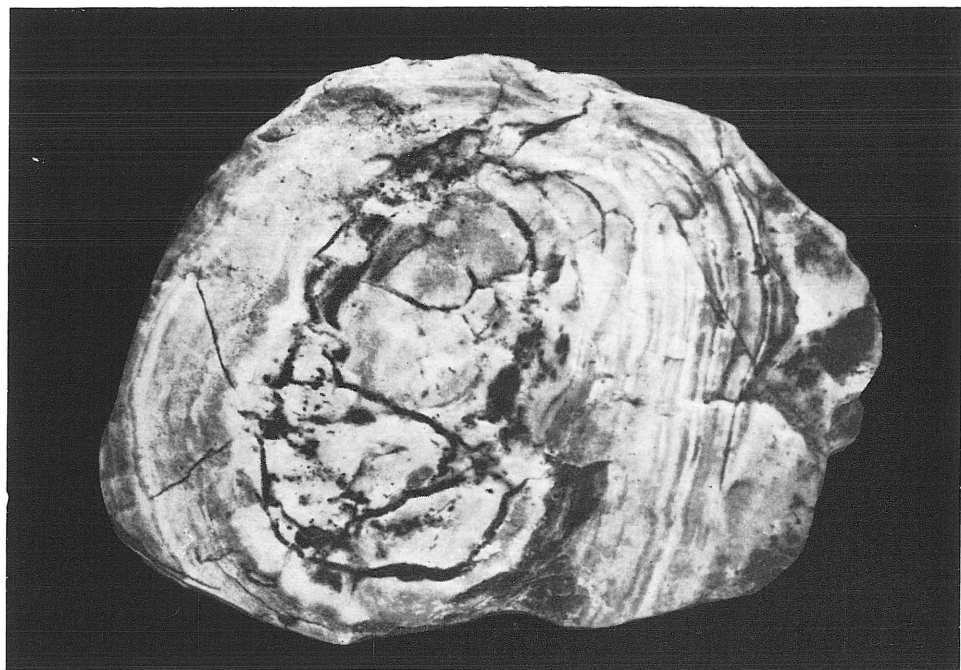
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František Němec: Rostlinné otisky z železitých konkrecí od Hrutova (u Lišova v jižních Čechách). — Fossil plants from the iron stones of Hrutov (near Lišov in S. Bohemia).

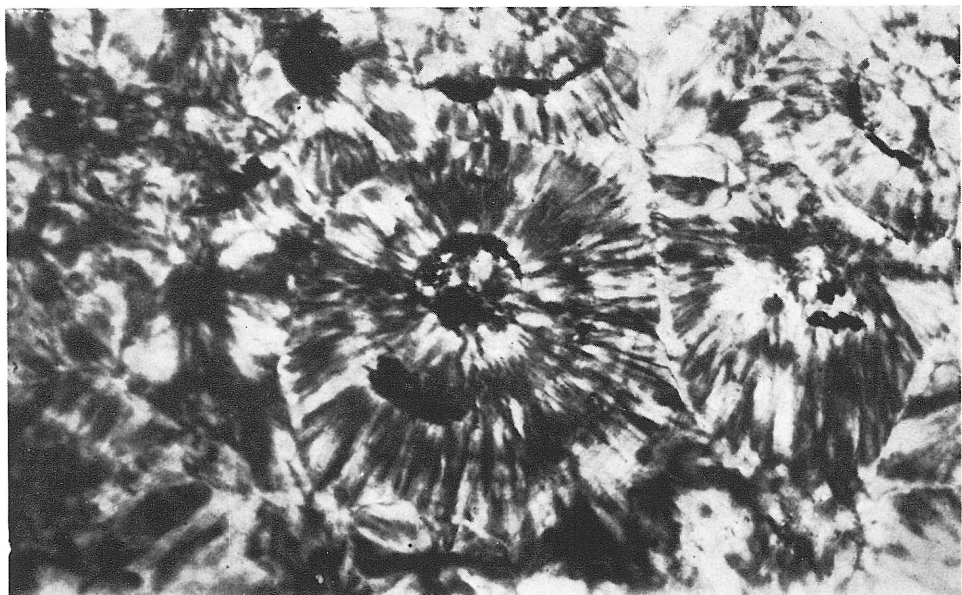
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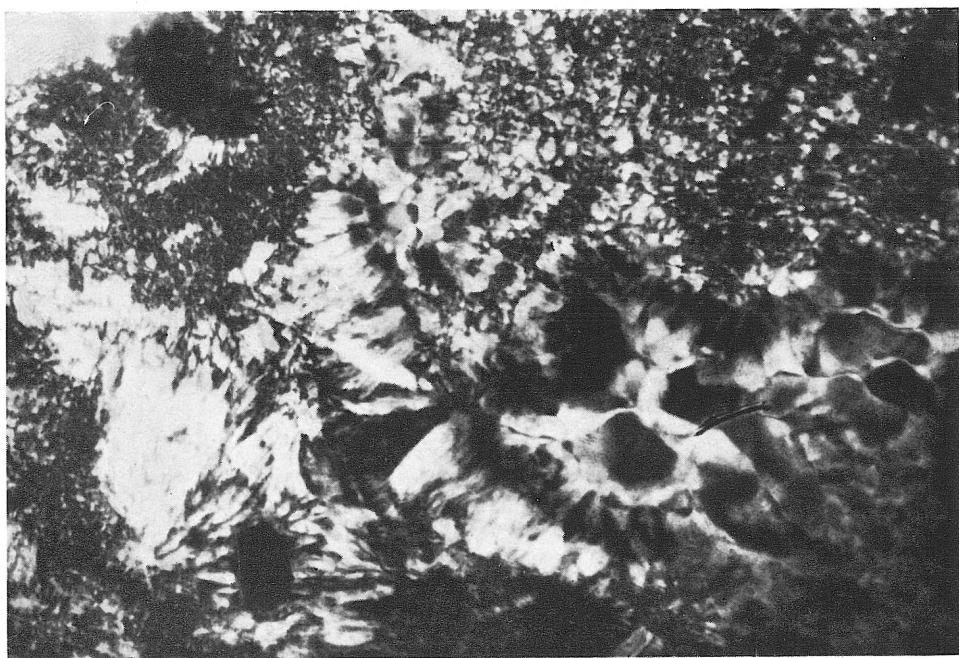
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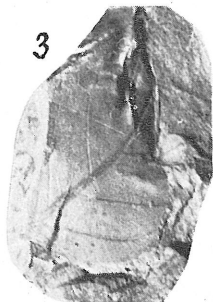
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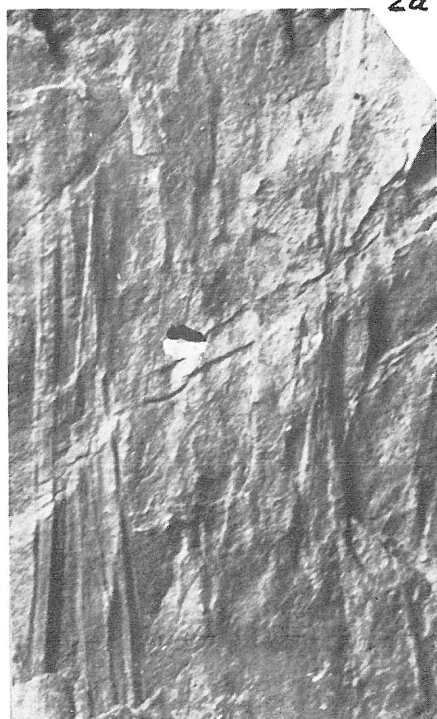
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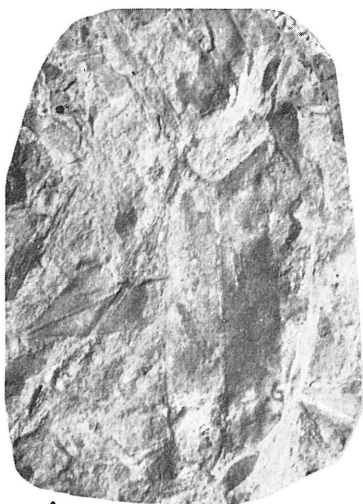
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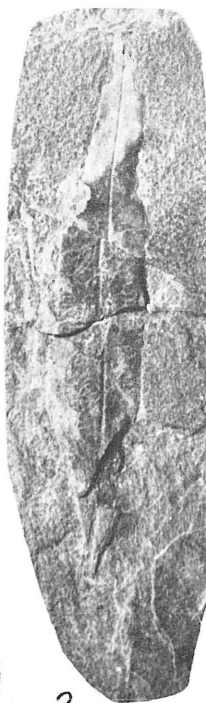
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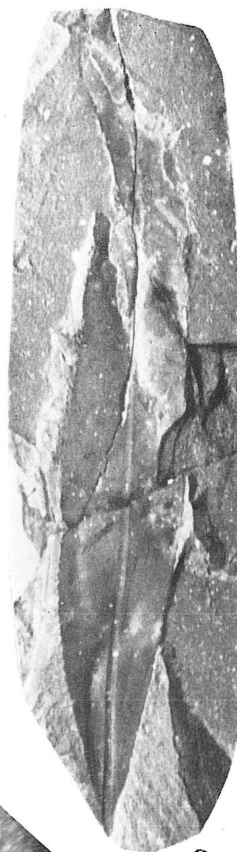
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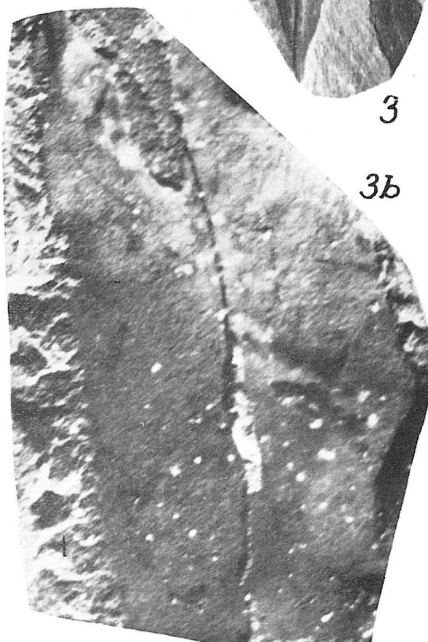
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3a



3b

