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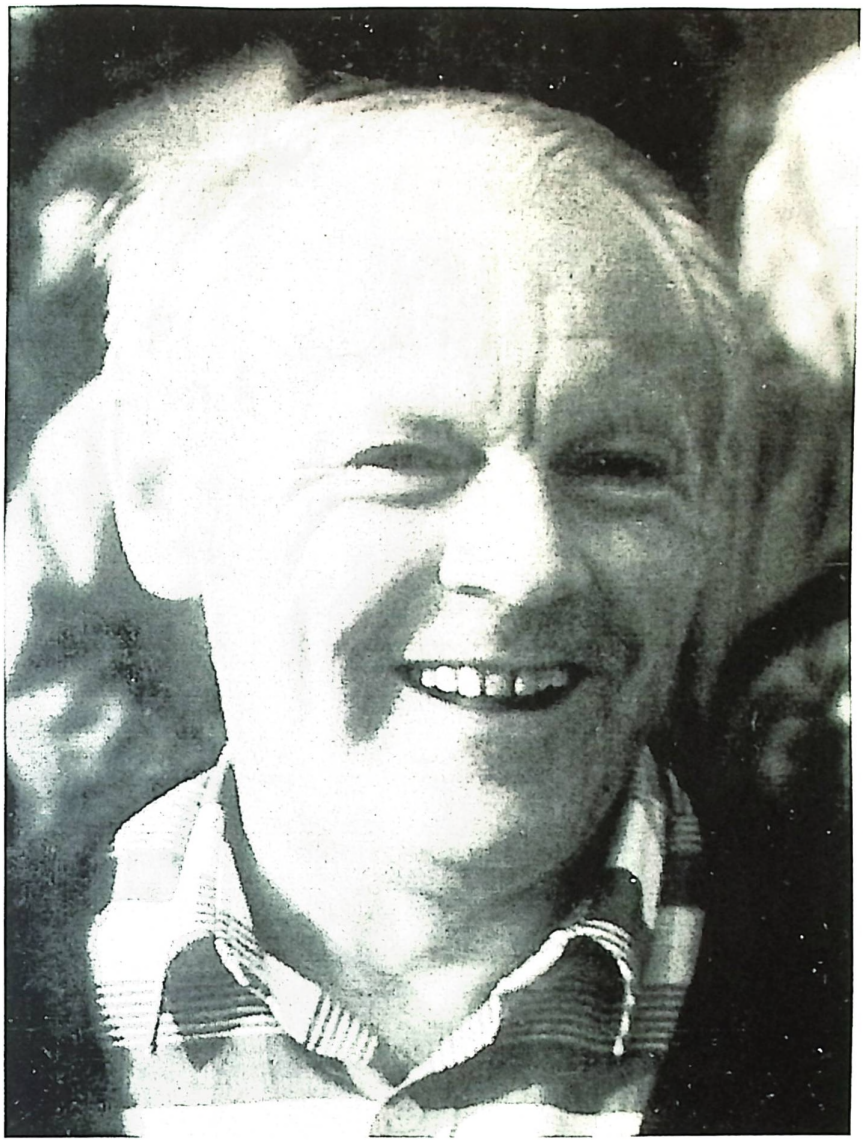

In memoriam Erwin Knobloch † 1934-2004

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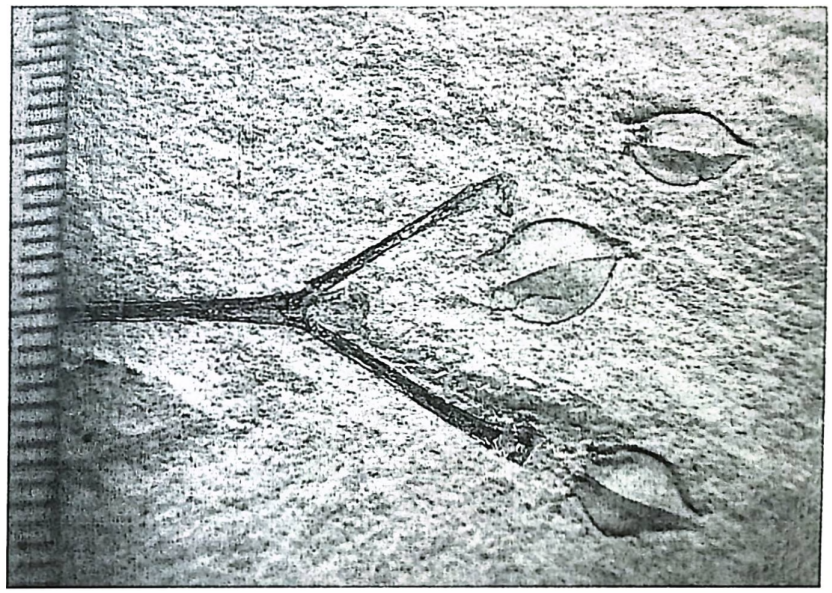
FLORA TERTIARIA MEDITERRANEA VI.9

Tilia knoblochii nov. spec., the first occurrence of bracts with capsules in Greece, with remarks on the geology of the Aliveri-Kymi-Basin (Lower Miocene, Evia)

E. VELITZELOS, D. VELITZELOS & H.-J. GREGOR



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Tilia knoblochii nov. spec., the first occurrence of bracts with capsules in Greece, with remarks on the geology of the Aliveri-Kymi-Basin (Lower Miocene, Evia)

E. VELITZELOS, D. VELITZELOS & H.-J. GREGOR

Summary
The Aliveri-Kymi-Basin in Evia (Greece) is tectonically caused and underlain by Triassic-Jurassic limestones. The filling of the basin are limnic clays, calcareous mud, sands and lignites, overlain by coarser sediments of fluviatile character. The horizon above the first libgnite seam yielded a rich flora, known in the 19. and 20. century as the Kumi-flora.
The first occurrence of a bract from *Tilia knoblochii* nov. spec. with adjoining fruits (capsules) fits very well into the composition of a laurel forest with conifers and partly bottomland elements – well known in Europe from the Lower Miocene.

Zusammenfassung
Es wird der erste Nachweis einer fossilen Lindenart – *Tilia knoblochii* nov. spec. im griechischen Jungtertiär mitgeteilt. Das Fossil besteht aus Braktee und Kapseln, also ist die ganze Flugfrucht erhalten. Die Ablagerungen von Kymi sind untermiozänen Alters und haben seit UNGERS Zeiten (Kumi-Flora genannt), seit 1867 eine reiche Flora geliefert. Die Füllung des tektonisch bedingten Aliveri-Kymi-Beckens besteht aus limnischen Tonen, Sanden, Braunkohlen und Kalkmergeln, welchletztere die Funde geliefert haben.

Key words: *Tilia,* bracts, fruits, Lower Miocene, Kymi/Evia
Schlüsselwörter: *Tilia*, Brakteen, Früchte, Untermiozän, Kymi/Euböa

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1 General introduction

The island of Evia (Euboea) is the second largest Greek island facing the southeastern part of the Hellenic peninsula. It is situated between the peninsular massifs Othrys and Pelion in the northwest and the island complex in the southeast (Fig. 1). The Neogene of the island of Evia (Euboea) has attracted the attention of palaeontologists and geologists since the very beginning of the scientific exploration of this area in the 19th century. During the last few decades the intensity of the palaeontological research has increased and many new data have accumulated. Several new sites have been discovered and are currently under investigation. Neogene continental deposits containing fossils are exposed in various parts of the island and adjacent territories. One of the islands of particular interest is Illiodroma (i.e. Alonissos in the present geography of Greece), which is the type locality of the common Tertiary conifer *Glyptostrobus europaeus*. The partial lignite basin of Aliveri on the southwestern coast of Evia is filled with lignite-bearing deposits corresponding partly to the outcrops of Kymi. Fossil remains were explored there in the 1980-90s (e.g., KATSIKATOS et al. 1981, BENDA & de BRUIJN 1982, GREGOR 1983, VELITZELOS et al. 1992), when the lignite was exploited in the open pit Plakes at the Prinias village. Unfortunately, the fossiliferous marl is no longer accessible there. The main fossiliferous sites are situated in the northern part of Kymi near the village Vitalo which is famous for providing the so called Vitalo stone which is in fact marl with high content in silica and has been traditionally used for constructing fences and houses (Pl. 1, figs. 1,2). The occurrence of the these fine laminated marls continues all the way down to the beach of Kymi when its visible to see that the marl horizon dives into the sea. On the coastal road of Kymi it is possible to nice sections consisting of marls rich in fossils (pl. 1, fig. 3).

1.1 Geotectonics

From the viewpoint of geotectonics, southern Evia consisting of metamorphic formations is part of the crystalline massif Attica-Cyclades (Bornovas et al. 1983). It is regarded as a multiphase double window (Katsikatsos et al. 1986). The other part – the carbonate non-metamorphosed series of the central and northern zones belong to the sedimentary series of the Inner Hellenides (GUERNET 1971, DERCOURT ET AL. 1977, KATSIKATSOS 1970) formely known as Subpelagonian zone (Aubouin 1957, 1963, Aubouin et al. 1963) or as East-Greek series (RENZ, 1940).

1.2 The Neogene deposits

According to Katsikatsos et al. (1981) all Neogene deposits of the island of Evia, except for minor brackish intercalations in a section near Vlachia, are of continental origin. The successions found in the three major sedimentary basins (the Aliveri-Kymi Basin, the Palioura-Gides Basin, and the Limni-Istiea Basin, (Fig.1) are lithologically roughly similar. In each of these basins the Neogene can be divided into a "lower" unit of predominantly fine-grained lacustrine sediments, which locally contain lignite deposits locally, and an "upper" unit consisting of mainly coarse-grained fluviatile sediments. The lithological similarity of the various basins has generally been attributed to their similar overall geological history, and this interpretation has subsequently led to the time correlation of similar lithologies. The "lower" unit has been considered by most workers to be of Early Miocene age, the "upper" unit of Late Miocene age (Section).

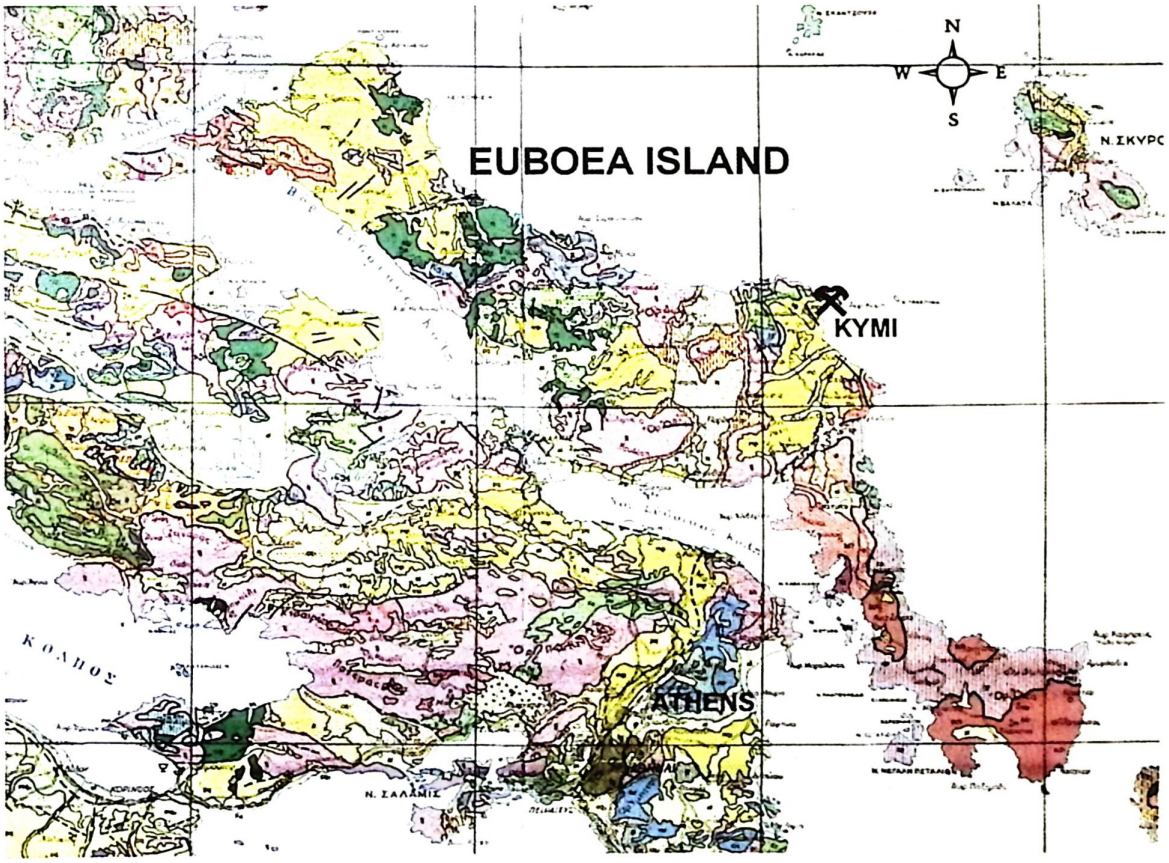

Fig. 1 The geological map of Euboea island Greece. Geological map of Greece 1:50.000 Bornovas, J., Rondoyanni-Tsiambaou Th., IGME, 1983.

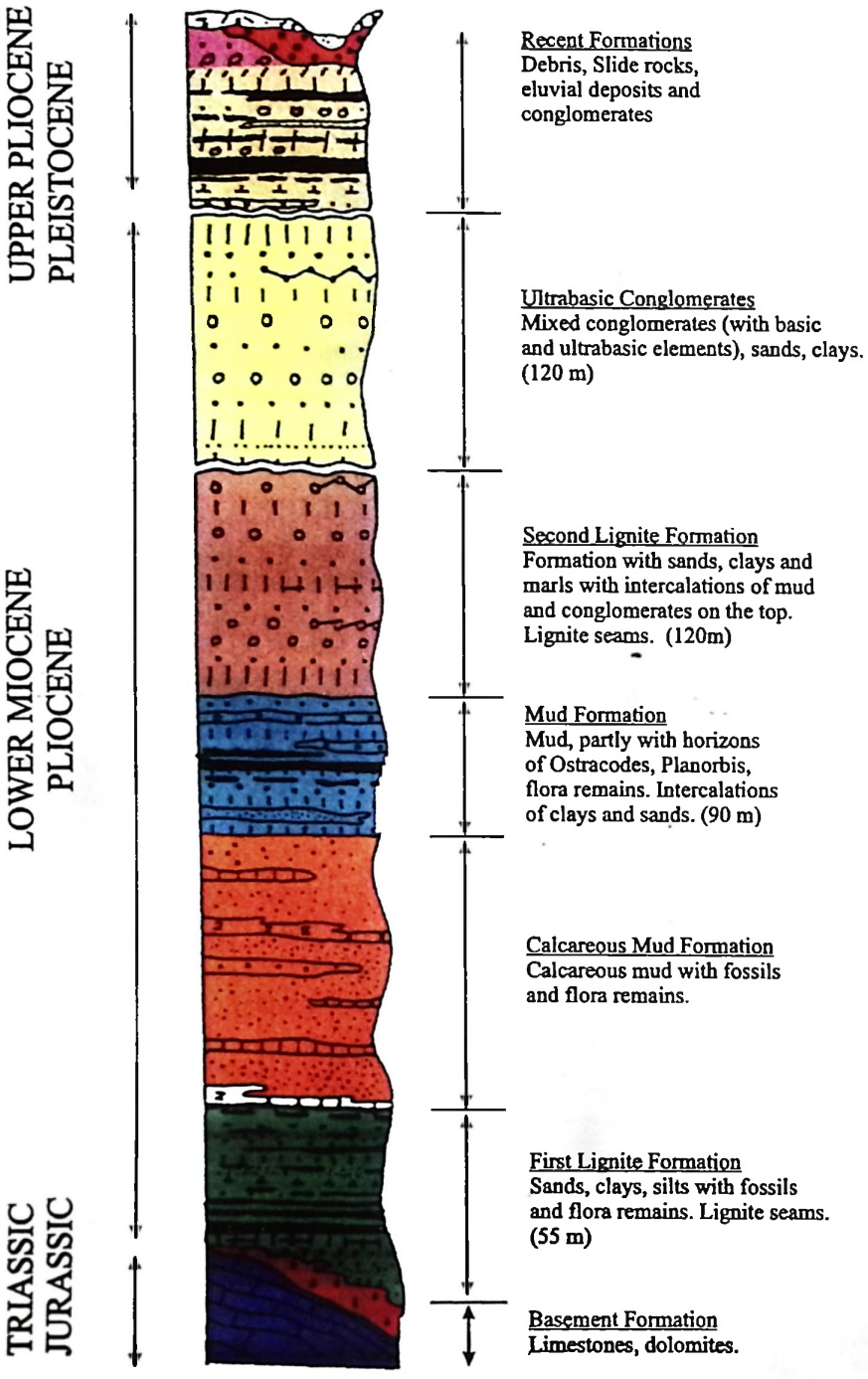

Fig. 2 Synthetic stratigraphical column of the Neogene - Quaternary deposits (Yiakkoupis et al. 1998)

These age determinations are based largely on the flora (GAUDRY, 1860, SAPORTA, 1868, DEPRAT, 1904, GUERNET & SAUVAGE, 1969), but local occurrences of a mollusc fauna (Gorcel 1878; Guernet 1971) and a mammal fauna (MITZOPOULOS 1947, DEPRAT, 1904, CORDELLA 1878, WOODWARD 1901) have also been considered. The occurrences of Neogene sediments near Styra near Almyropotamos along the southwestern coast and near Vlachica is of minor geographical as well as stratigraphical importance. They consist almost exclusively of coarse- grained red-bed deposits, except for the deposit near Almyropotamos.

2 The Aliveri-Kymi Basin

2.1 General

The Neogene sedimentary basin of Aliveri-Kymi (Fig.1) extends roughly in a northerly direction from north of Aliveri to the fault-controlled north-east coast. The on-land part of the basin covers an area of around 200 km^2 between the mountains of Mavrovouni in the northwest and those of Octonia in the southeast. It is not known how far this basin extends northwards into the Aegean Sea. The Neogene sediments can be divided into two units, which in the southern part of the basin, near Aliveri, are separated by a distinct unconformity. In the northern part of the basin, near Kymi, where the section is much thicker, these units pass gradually merge into each other (fig. 2).

2.1.1 The lower unit.

The total thickness of the predominated lacustrine sediments of the lower unit varies considerably from some 40m in the open cast mine of Aliveri to several hundreds of meters in the area of Kymi, but the general succession is similar throughout the area. From bottom to top can be distinguished a unit of alternating plastic clays, sandstone and conglomerates, which in the southwestern part of the basin and the nortrhwestern part of the basin is overlain by lignites. The geographically quite restricted lignite occurrences are overlain by well stratified marls and marly limestones which at the lower parts are slightly folded. The sediments of the lower unit are pierced by small volcanoes in the area south of Kymi. The age of the volcanic rocks has been determined as around 13 Ma by FYTIKAS et al. (1976).

2.1.2 The upper unit.

The contact between the predominantly fluviatile sediments of the upper unit and the lacustrine deposits of the lower unit is clearly unconformable in the area of the Aliveri lignite mine where the red-coloured sandy clays, sandstones, and conglomerates of the upper unit cover an erosional surface. The components of the conglomerates suggest that the source area for these deposits has to be searched for in the metamorphic rocks of southern Evia. The conglomerates, which contain boulders as large as 5 m^3 show a general trend to became coarser from bottom to top and from west to east. The thickness of the upper unit ranges from about 50 meters in the open-cast mine of Aliveri to over 200 meters in the area of Avlonori-Octonia.

2.2 The age of the Neogene deposits of Aliveri-Kymi.

The lower unit has been studied intensively because of the economic importance of the lignite. Palaeontological age determinations suggested for these deposits by previous workers are based primarily on the fossil flora. The lignite deposits near Aliveri and Kymi, which mainly consist of typical swamp vegetation, have been considered to be of Aquitanian age by SAPORTA (1868), GUERNET & SAUVAGE (1969), BRUIJN et al. (1980), KATSIKATSOS et al. (1981) VELITZELOS et al 1982,1983,1985: IOAKIM,1984,1988, DOUKAS, 1986). These authors have considered the whole sequence to be of Early Miocene age. DEPRAT (1904), however, placed the lacustrine marls, which conformably overlie the lignites into the Sarmatian. FYTIKAS et al. (1976) dated the volcanic rocks, which pierce the series south of Kymi to around 13 Ma, which determines a maximum age for the top of these deposits.

3. The fossil *Tilia knoblochii* nov. spec.

3.1 Bract and capsules

Familie: Tiliaceae (For family and genus compare SCHUMANN 1895)
Genus: *Tilia* LINNÉ.

***Tilia knoblochii* nov. spec.**
Pl. 3, figs. 1-6, Pl. 4, figs. 6,7

Diagnosis:
Bract 80 mmm long, 15-20 mm broad with a stalk coming from the middle of the bract. The nerves are very variable and run to the smooth margin in a angle of about 45°. Upper part of the bract with connected nerves, hinging to one another.
Fruits capsules (7 mm long and 5 mm in diameter), with a smooth surface and 4-(5?) valves; stalk 14 cm long.

Holotype: No: EVIA-2004-1
Locus Typicus: The fossil site is Paralia Beach near Kymi, Evia, Greece
Stratum typicum: Lower Unit (Lower Miocene, MN 4b, Burdigalian),
Derivatio nominis: we designated the new species to our late friend and colleague Erwin KNOBLOCH from Prague
Deposition: Geology Dept., Univ. Athens, Coll. VELITZELOS, Greece

Description:
The bract is about 80 mmm long, 15-20 mm broad and has a thin stalk, coming out from the middle of the bract. The nerves, very variable as it always is in these wings, run to the outer margin in a angle of about 45°, varying from 30-90°. In the upper part of the bract we have nerves, hinging to one another..
The fruits are slightly elongated, typical capsules (6,5 – 8,0 mm long and 4,5 – 6,0 mm in diameter); they have a smooth surface and four to five valves. Four of these capsules are sitting on the stalk, coming out of the bract. The whole stalk is 14 cm long, the separating fruitbearing one is 8 cm long up to the first bifurcation and 10 cm to the second. The uppermost capsule bearing stalks are 2 cm long.
The fossil is a winged fruit, a bract, like it is typical for the extant species of the genus *Tilia*. *Tilia* is common in many Tertiary sediments in Germany, Spain, France or Poland and the Czech Republic. The only existing fossil from this genus in Greece was found in the laminated marls of Kymi.
The fossil is preserved in a unique manner, naturally as a print only, but we must have in mind, that it is the only one fossil fruit-type of this taxon in whole Greece. Tissue is not available at all.

3.2 Comparisons with recent species
Some of the most important literature is mentioned here in comparing our fossil with extant species.
The Iconographia Cormophytorum Sinicorum, II, 1972: (791-796) yields the chinese species for a comparison: *Tilia amurensis* RUPR., *Tilia mongolica* MAXIM., *Tilia henryana SZYSZ. Tilia mandshurica RUPR. et MAXIM., Tilia miqueliana MAXIM., Tilia oliveri* SZYSZ., *Tilia Chinensis* MAXIM., *Tilia tuan* SZYSZ., *oblongifolia* REHD., *Tilia endochrysa* HAND.-MAZETT., *Tilia croizatii* CHUN et WONG. Only three species have somewhat comparable bracts and fruits, but not too convincing by means of size and shape:
Tilia henryana, Tilia chinensis and *Tilia oblongifolia* (ibid. 792-795, Fig. 3314, 3318, 3320).

Also in America we find different *Tilia* species (SARGENT 1965, S. 377-749):
Tilia americana L., *Tilia venulosa* Sarg., *Tilia nuda* SARG., *Tilia littoralis* SARG., *Tilia crenoserrata* SARG., *Tilia floridana* SMALL, *Tilia cocksii* SARG., *Tilia neglecta* SPACH.,

Tilia caroliniana MILL., *Tilia texana* SARG., *Tilia phanera* SARG., *Tilia lasioclada* SARG., *Tilia heterophylla* VENT., *Tilia monticala* SARG., *Tilia georgiana* SARG.
Here all the species have smooth, rounded sphaerical capsules, which are by no means comparable to our fossils, missing the angled rims of the valves. Only *T. neglecta* has some furrows.

In KRÜSSMANN 1978 (S. 418-423) we find the following species:
Tilia cordata MILL., *Tilia platyphylla* SCOP., *Tilia euchlora* K.KOCH, *Tilia mongolia* MAXIM., *Tilia europaea* L., *Tilia japonica* (MIQU.) SIMONKAI, *Tilia tomentosa* MOENCH., *Tilia miqueliana* MAXIM., *Tilia oliveri* SZYSZ., *Tilia petiolaris* DC., *Tilia maximowicziana* SHIRAS, *Tilia mandshurica* RUPR. & MAXIM., *Tilia intensa* REHD. & WILSON, *Tilia heterophylla* VENT, *Tilia chinensis* MAXIM.
Most of the fruits are rounded, sphaerical to obovoid and have no similarity with our fossils. Only a few are 5-angled and the comparable *T. cordata* has fruits with a maximum diameter in the upper part of the capsule. Also *T. europaea* is somewhat similar, as it is with *T. heterophylla*, but they are all too much rounded. *T. mongolica* has tiny capsules with missing rims. The Asiatic specimens have more angled fruits as the American ones.

A comparison with extant species in Europe allows to consider some species as being very similar to our fossil: *Tilia cordifolia* and *Tilia mandshurica.*

3.3 Comparisons with fossil species
We have to compare our greek fossil especially with the following species:

1963 *Tilia praeplatyphyllos* SZAFER: 72-73, Taf. XIX, Fig. 3-7 from Stare Gliwice in Poland, Upper Miocene Clays
1982 *Tilia praeplatyphyllos* - GREGOR: 115, Taf. 8, Fig. 1-14, from Goldern near Landshut, Upper Freshwater Molasse
1985 *Tilia atavia* – SPITZLBERGER, from Goldern in Bavaria, Upper Freshwater Molasse
1997 *Tilia* div spec.–bracts from Europe and Romania, GIVULESCU: 143-149

If we compare the original material from Stare Gliwice (SZAFER 1963) with the new object from Kymi, we have the following data: the capsules from Poland measure 4,0-5,0 mm in length and 3,0-4,0 mm in breadth, which is much smaller than the specimens from the Bavarian molasse with 10,0-12,0 mm in length and 7-9 mm in breadth (GREGOR 1982: 115).

SPITZLBERGER (1984) described a new species from the Bavarian molasse, *Tilia atavia,* which has aceroid leaves and also the bracts (ibid. Foto 1, Fig. 1-17) were nominated in the same way, which is not correct. We cannot say, that the leaves and the fruits hang on one tree, because we never found a twig with the two different organs together. So the leaves are called *Tilia atavia* and the fruits, as I proposed formerly as *Tilia praeplatyphyllos* SZAFER (GREGOR 1982: 115, Taf. 8, Fig. 1-14).
If we have in mind, that the name "*praeplatyphyllos*" is incorrect in the sense, that it is not possible to see an ancestor of *Tilia platyphyllos* in such isolated small fruits, the name is valid and can be expanded from the fruits to the bracts, because, as we have seen, *Tilia atavia* is not valid.
Additionally the bracts were not validly described, only the leaves. SPITZLBERGER dared to describe the leaves in Latin language to show his humanistic education, but in English language it would have been more useful for our foreign colleagues. The bracts from the latter

species are similar to the greek species and in this way we can compare the fossil from Kymi with *Tilia praeplatyphyllos* SZAFER.
As SPITZLBERGER described the variability of the margin base (flat to pointed), of the size (small to large), of the nervature (horizontal to a pointed angle), we can compare the species very well with other ones – but most of the other fossils are not well described. The author (ibid. p. 148-156) listed different species with bracts like *Tilia expansa* (SAPORTA & MARION 1872), *Tilia mastaiana* MASSALONGO & SCARABELLI (1859), *Tilia vindobonensis* Stur (1867) or *Tilia longebracteata* ANDRAE (1861) and many more from Middle Europe and from Asia and America. In Europe we have a lot of not very much convincing remains of *Tilia,* described under different names like those listed above.

Tilia longebracteata (KNOBLOCH 1969) from Moravska Nova Ves is not similar to our fossil, also the fruits are missing. *Tilia vindobonensis* (SCHIMPER 1864) has rounded fruits not similar to our ones. *Tilia tuberculata*, a common species in the Pliocene of Poland has pustulate fruits, not smooth ones like in our case.

GIVULESCU made a first attempt for a monograph of linden in the Neogene and mentiones the following species: *Tilia longebracteata* – a problematic bract without fruits; *Tilia megacarpa* (here pl. 4, figs. 1-4), *T. ovoidea* (here pl. 4, fig. 5) and *T. elenae* from Romania, *Tilia josephinae* is doubtful (ibid. p. 143-145, Pl. I and II). *Tilia ovoidea* hat triangular fruits, dissimilar to our specimens – the others all lacking them. The bracts, as usual, are very variable and difficult to compare, also because many are fragmentary. The Greek specimen ist absolute one of the best, ever found in Europe.

KATZ, KATZ & KIPIANI published (1965, p. 209, pl. 60,61) following Pleistocene species of *Tilia* as drawings, but only fruits:
Tilia amurensis RUPR., *Tilia cordata* MILL., *Tilia cordifolia* BESS., *Tilia mandshurica* RUPR. & MAXIM., *Tilia tomentosa* MOENCH
T. tomentosa capsules are warty fruits, *T. amurensis* rims, *T. cordata* are ovoid ones and there remain two species with good similarity to our fossils from Kymi: *T. cordifolia* has the right size, angles and outer morphology similar to our fossils. Only the size of the fruits is somewhat larger (6,0-10,0 x 6,6-8,0 mm). *Tilia mandshurica* has smaller fruits and more elongeated ones.

A definitively comparable fossil species of the taxon *Tilia* in respect to our fossil is not available, as could be seen.

4 Palecological and paleoclimatological setting
From this species alone we are not able to establish a theory about the ecological conditions and the climate at the time of the Kymi flora, the Lower Miocene. But together with the revised flora list (see Velitzelos 2002: 14, 15) we can assume a mesophytic laurel forest with elements of riparian characters, an aue-forest in a wet-humid subtropical or warm-temperate climate of typical Cfa-type sensu KÖPPEN (see BLÜTHGEN 1966).
The flora yields many species like pines, *Tetraclinis, Glyptostrobus, Alnus, Myrica, Comptonia, Engelhardia, Quercus, Daphnogene, Laurophyllum, Berberis, Populus, Platanus, Acer, Ziziphus, Zelkova,* legumes (VELITZELOS 2002) and – our *Tilia.*
The laurel forest is similar to the one from the Canary Islands and yields *Laurophyllum* and *Daphnogene*, also *Myrica*, the aue-forest is typical with *Alnus, Populus, Platanus, Zelkova,* and *Myrica* and legumes. Riparian conditions show elements like *Glyptostrobus, Acer, Myrica, Ziziphus* and *Zelkova.* A mesophytic forest is proven by *Quercus, Engelhardia,*

Comptonia, Acer and *Berberis*. A revision of a doubtful *Nerium* were made by VELITZELOS et al. 1983.
Putting together the paleophytical setting, these elements are typical for the Neogene laurel forest in whole Europe and the so called Cfa-climate, which is mentioned above.
That we have special conditions in our megaflora is clearly stated by the absence of *Salix, Fraxinus* and Hamamelidaceae. The unique occurrence of *Ceratostratiotes sinjanus* (GREGOR 1980, MELLER & BERGEN 2003), an index-fossil for Lower Miocene in Europe allows to reconstruct the beach of the Paratethys at that time on Evia – but at another time level. The specimens from Vienna (GREGOR, in prep.) surely belongs to another horizon than our *Tilia f*ossil, but the time span may be similar - Lower Miocene.

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We heartily thank Dipl.-Geol. Jannis Papayiannis, geologist, who found the fossil in the time of his diploma thesis at Kymi and gave it to author VELITZELOS. We are also indebted to the Herbarium of the Institute of Botany in Munich for possibilities to make investigations on Recent *Tilia*-species.

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Plate 1

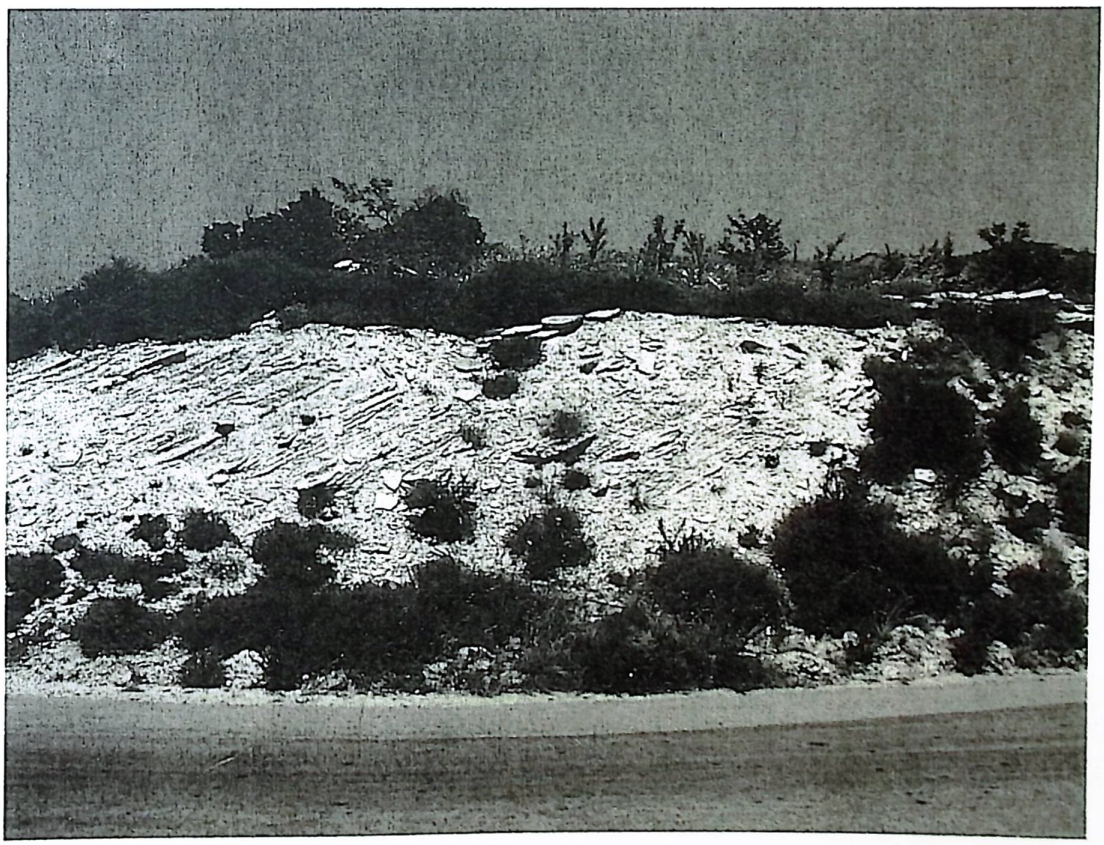
The fotos were made by the authors VELITZELOS

Fig. 1: Fossil site where the Tilia-bract was found

Fig. 2: Road outcrop with Lower unit of Kymi strata

Plate 1

1



2

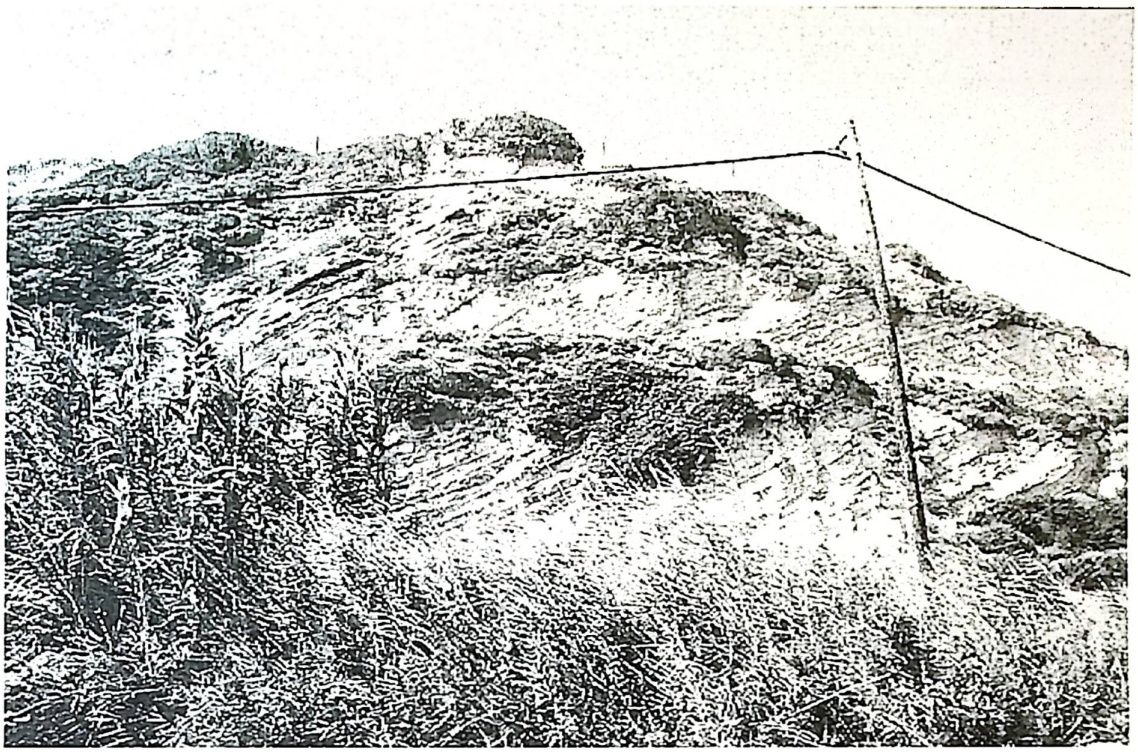
Plate 2

The fotos were made by authors VELITZELOS (1) and GREGOR (2)

Fig. : Area of inclined marly strata from Kymi near the beach

Fig. 2: *Tilia knoblochii* nov. spec. from the Lower Miocene of Kymi, Evia, Greece; overview

Plate 2



1

2

Plate 3

The fotos were made by author GREGOR

Fig. 1-6: *Tilia knoblochii* nov. spec. from the Lower Miocene of Kymi, Evia, Greece;

Fig. 1: overview with sediment plate, a marly shell-like splitting plate

Fig. 2: upper part of winged bract

Fig. 3: basal stalk with beginning of the wing

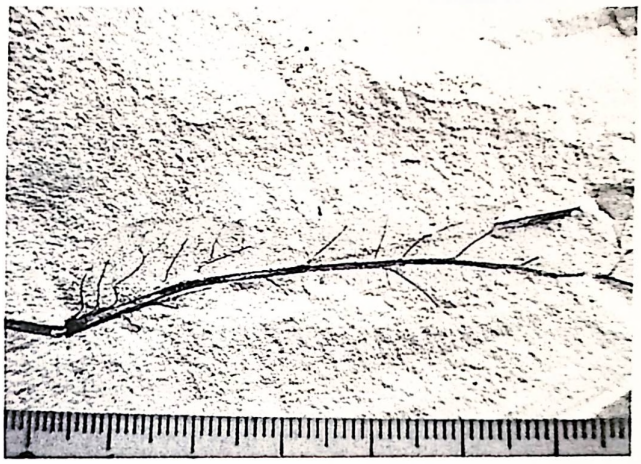
Fig. 4: central stalk with wing

Fig. 5: upper part of bract with fruits, sepatated from the stalk

Fig. 6: magnification of fig. 5

Plate 3

1



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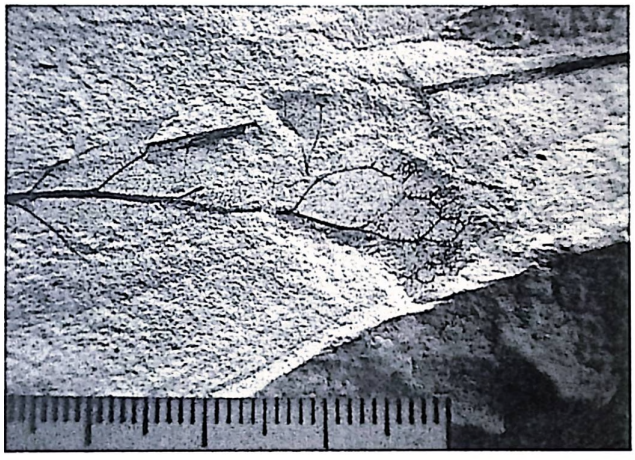

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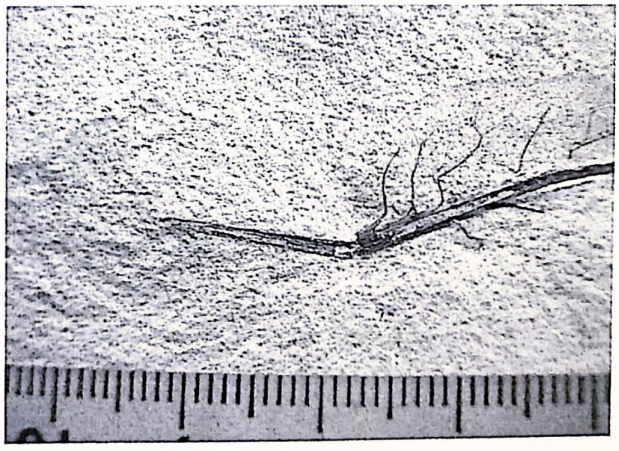


3

6

Plate 4

The fotos 6 and 7 were made by author GREGOR

Fig. 1-4: *Tilia megacarpa* GIVULESCU von Chiuzbaia (Pliozän)

Fig. 1: partial bract with long stalk, after GIVELESCU 1997: pl. 1, fig. 1

,

Fig. 2: broken bract with long axis to fruits, after GIVELESCU 1997: pl. 1, fig. 2

Fig. 3: bract without fruits, after GIVELESCU 1997: pl. II, fig. 11

Fig. 4: fruitless bract , after GIVELESCU 1997: pl. II, fig. 11

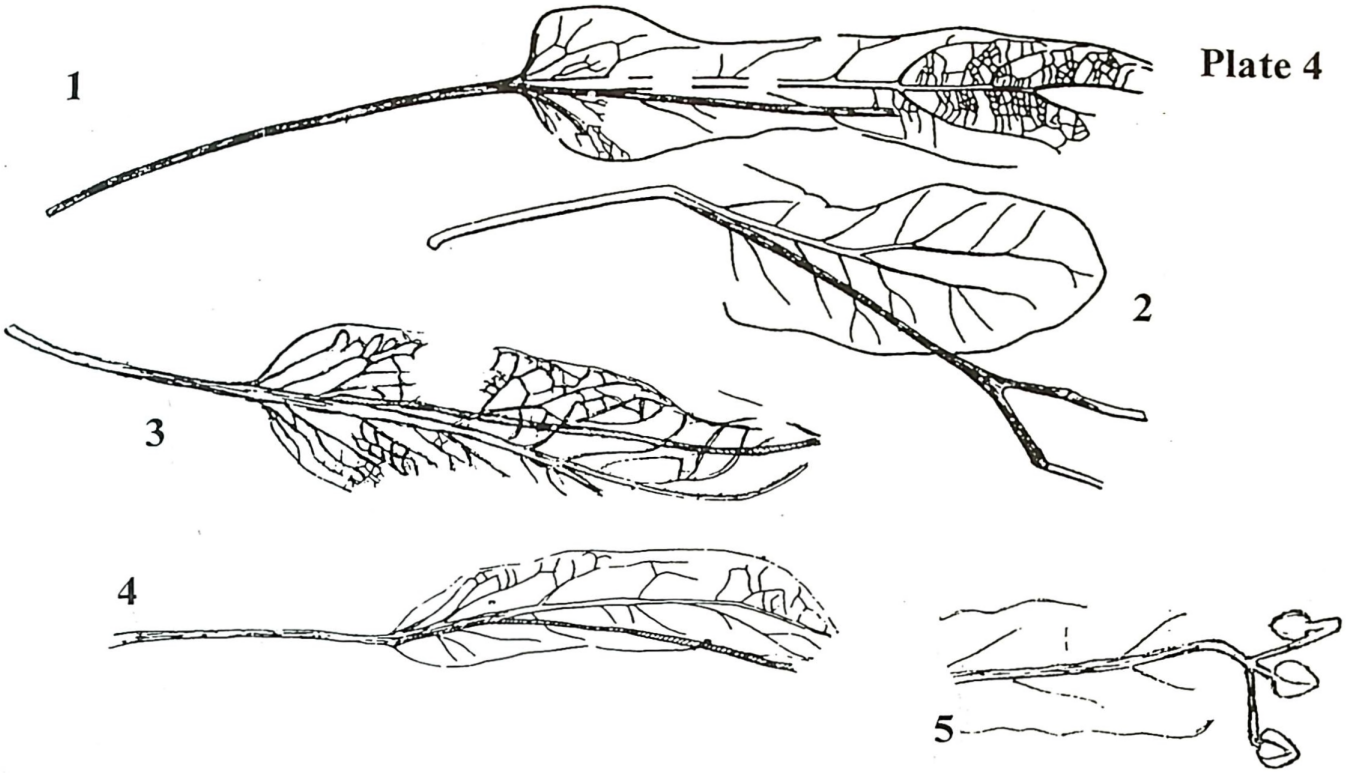
Fig. 5: *Tilia ovoidea* GIVULESCU, after GIVULESCU, 1997, pl. II, fig. 1 from the Pliocene of Chiuzbaia

Fig. 6, 7 : *Tilia knoblochii* nov. spec. from the Lower Miocene of Kymi, Evia, Greece;

Fig. 6: drawings on the foto, showing the outlines of the bract and nervation

Fig. 7: special illumination of the foto with bract and fruits

Plate 4



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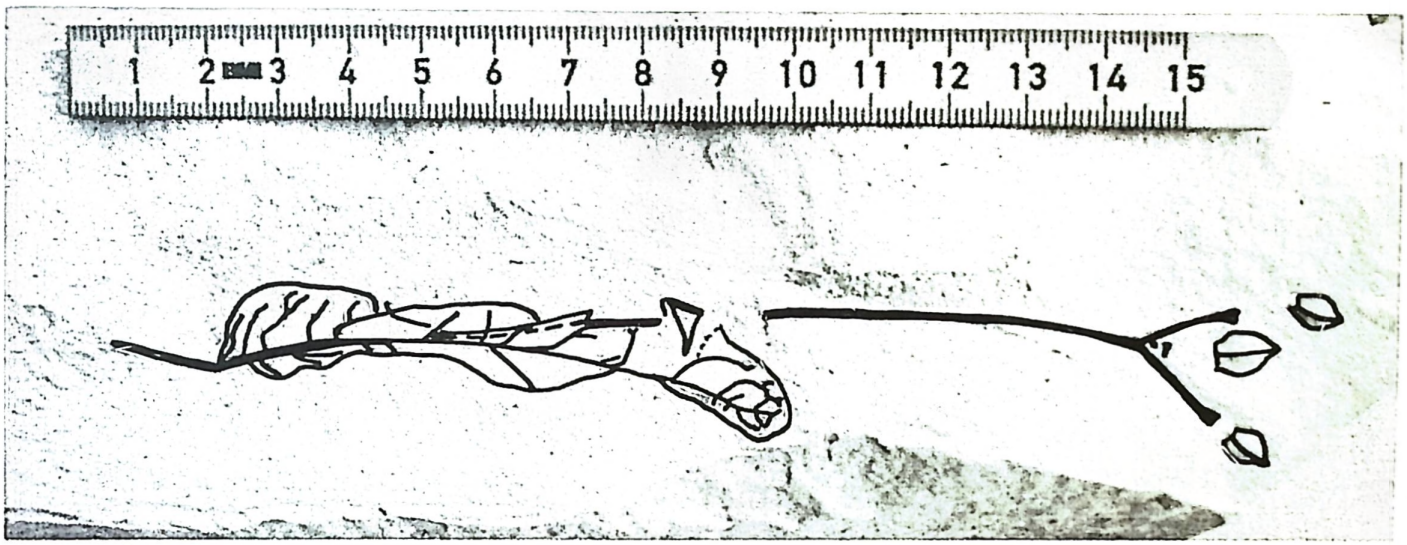

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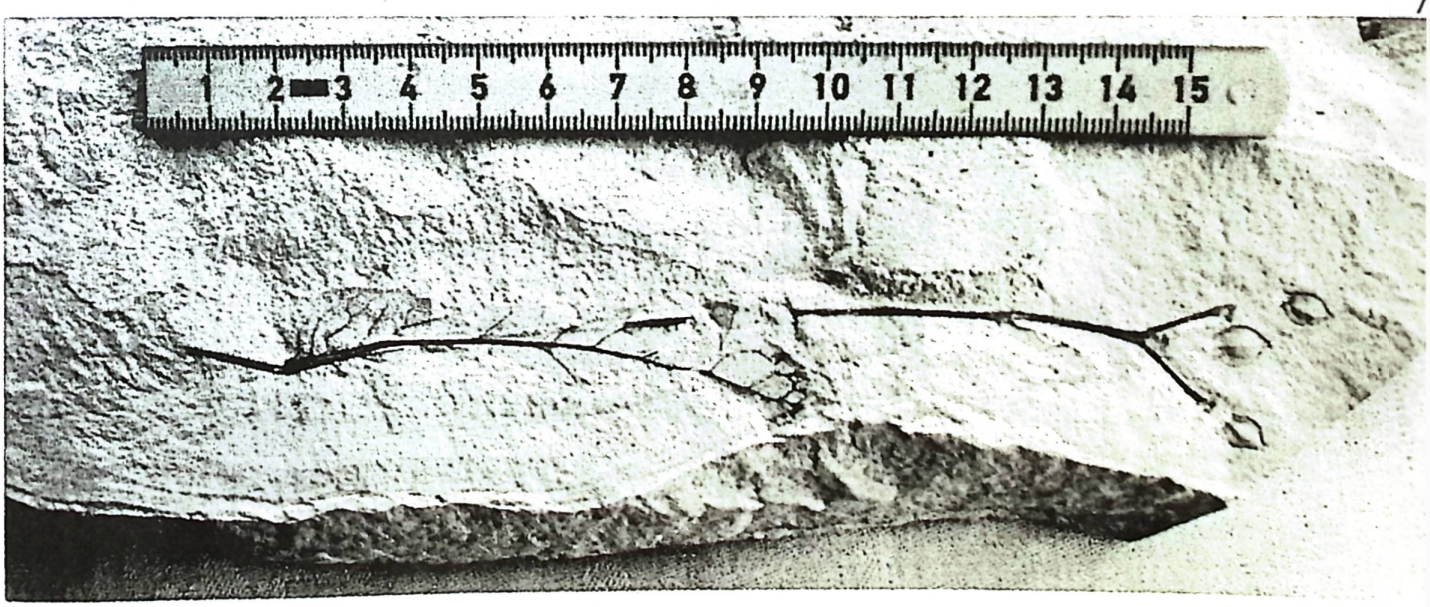

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