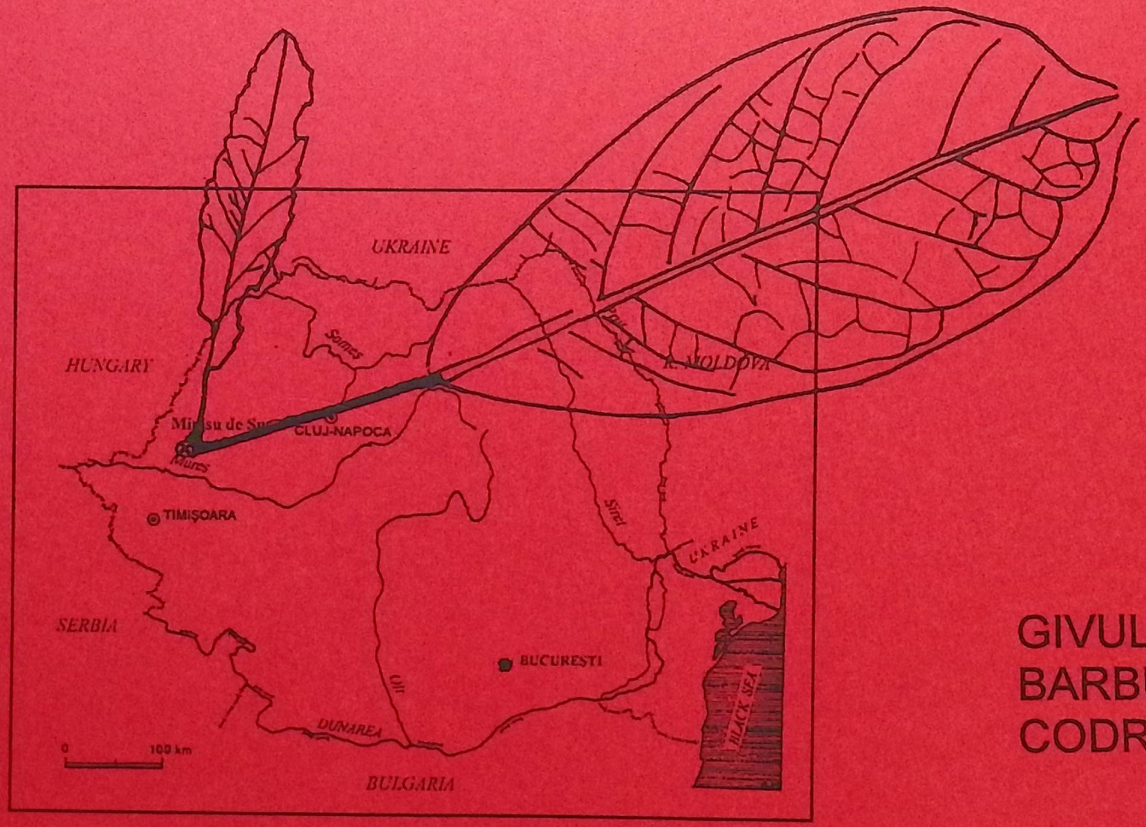
documenta naturae no. 144

München 2002

THE SARMATIAN FLORA FROM MINIŞU DE SUS, ROMANIA



GIVULESCU
BARBU
CODREA

DOCUMENTA NATURAE

Nr. 144 2002

ISSN 0723-8428

Herausgeber der Zeitschrift Documenta naturae im Verlag (Publishing House) Documenta naturae - München (Munich)

Dr. Hans-Joachim Gregor, Daxerstr. 21, D-82140 Olching
Dr. Heinz J. Unger, Nußbaumstraße 13, D-85435 Altenerding
Priv.-Doz Dr. Diethard H. Storch, Sägematte 2, D-79183 Waldkirch

Die Zeitschrift erscheint in zwangloser Folge mit Themen aus den Gebieten Geologie, Paläontologie (Lagerstättenkunde, Paläophytologie, Stratigraphie usw.), Botanik, Anthropologie, Domestikationsforschung, Vor- und Frühgeschichte u.a.

Die Zeitschrift ist Mitteilungsorgan der Paläobotanisch-Biostratigraphischen Arbeitsgruppe (PBA) im Heimatmuseum Günzburg und im Naturmuseum, Im Thäle 3, D-86152 Augsburg

Die Sonderbände behandeln unterschiedliche Themen aus den Gebieten Kunst, antike Nahrungsmittel, Natur-Reiseführer oder sind Neuauflagen alter wissenschaftlicher Werke oder spezielle paläontologische Bestimmungsbände für ausgewählte Regionen.

Für die einzelnen Beiträge zeichnen die Autoren verantwortlich, für die Gesamtgestaltung die Herausgeber.

Überweisung des Heftpreises erbeten auf das Konto 1548460 bei der Sparkasse Fürstenfeldbruck (BLZ 700 530 70) - Inh. H.-J. Gregor.
Bestellungen: bei Buchhandlungen und den Herausgebern (s.o.)

©copyright 2001 Documenta Verlag. Das Werk einschließlich aller seiner Teile ist urheberrechtlich geschützt. Jede Verwendung außerhalb des Urheberrechtsgesetzes bedarf der Zustimmung des Verlages. Das gilt insbesondere für Vervielfältigungen jeder Art, Übersetzungen, Mikroverfilmungen und für Einspeicherungen in elektronische Systeme.

Gestaltung und Layout: Juliane Gregor und Hans-Joachim Gregor

Umschlagbild: Geographische Karte von Rumänien und fossile Blätter von Minisu de Sus

München 2002

Documenta naturae	144	S.1-35	2 Abb.	3 Tafeln	München	2002

THE SARMATIAN FLORA FROM MINIŞU DE SUS, ROMANIA

DIE SARMATISCHE FLORA VON MINIŞU DE SUS, RUMÄNIEN

R. GIVULESCU *, O. BARBU ** & V. CODREA **

Adressen der Autoren:

Prof. Dr. Răzvan GIVULESCU - 17 Donath St., M2, Ap. 66, 3400 Cluj-Napoca, România

Dr. Ovidiu BARBU ** & Dr. Vlad CODREA - Babeş - Bolyai University, Dept. of Geology-Palaeontology, 1 Kogălniceanu St., 3400 Cluj-Napoca, Romania

Abstract. The paper deals with the macro flora from Minişu de Sus, within the Zarand Depression, Arad district, western Romania, which age is Early Sarmatian. The identified taxa belong to 13 families, 18 genera and 27 species (4 of them uncertain). The macro floristic remains originating from different assemblages are evidence for a Lower Sarmatian environment that evolved in a warm-temperate climate, fairy wet. In several areas, swampy tendencies were obvious.

Key words: Early Sarmatian; macro flora; western Romania.

Zusammenfassung. Die Arbeit beschreibt die Makroflora von Minişu de Sus, Zarand – Vertiefung, Arad Bezirk, West – Rumänien, die dem Jungsarmatian angehört. Die identifizierten Taxen gehören zu 13 Familien, 18 Gattungen und 27 Arten (4 davon unsicher). Die Makroflorareste, die von verschiedenen Gesellschaften stammen, beweisen eine sarmatische Umwelt, die sich in einem warm-gemäßigten (ziemlich feuchten) Klima entwickelte. In einigen Gebieten gab es offensichtlich sumpfige Tendenzen.

Schlüsselwörter: Jungsarmatian, Makroflora, West – Rumänien.

1 Introduction and Acknowledgement

The Minişu de Sus area (Arad District) is located in the western part of Romania, within the Miocene Zarand Basin. This structural unit begun to develop in the Late Badenian, or even in the Lower and/or Middle Badenian if considering the age of the Botfei Formation (CODREA et al. 1999), as a post-tectogenetic basin generated on the western side of Apuseni Mountains (Fig. 1).

The basin infill is represented by Late Badenian, Sarmatian and Pannonian *s. str.* molassic deposits.

A typical succession of Volhynian deposits, described under the name of "the diatomaceous-tuff complex" can be followed in the area comprised between Minişu de Sus - Minişel - Tauţi villages. It consists of numerous diatomite layers, interbedded with andesitic rocks as lapillistones, volcanic sands, tuffs, bentonites or volcanic agglomerates. All these reflect an intense Sarmatian volcanic activity. The whole sequence was protected against erosion by a thick plate of andesitic agglomerates, which is present in the upper part of the studied logs.

The data regarding the regional stratigraphy, as well as the separation of the different stratigraphic terms can be found in several publications (*e.g.* ISTOCESCU 1971, ISTOCESCU & ISTOCESCU 1974, SAGATOVICI & ANASTASIU 1972, CODREA et al. 1999, SĂSĂRAN et al. 1999).

In a series of quarries extracting diatomite (Bârzăviţa I and II, Stupii Surdului, Pârâul Neamţului) one can note a main unconformity located between the Lower Sarmatian (Volhynian, *sensu* Suess) deposits and the older metamorphic and Permo-Mesozoic basement belonging either to Biharia or Codru nappes. In other sections, the Sarmatian lies in conformity with the Upper Badenian Minişu de Sus Formation (NN 7; CODREA et al. 1999).

Over the years, a rich collection of fossils was collected from the above-mentioned quarries, including both flora and fauna: KRESTEL 1970, NICORICI 1976, GIVULESCU & RÜFFLE 1986, CODREA et al. 1991a, b, CODREA 1992, GIVULESCU et al. 1995, BARBU & CODREA 1996, CODREA & BARBU 1996 a, b, VREMIR et al. 1997.

Authors kindly thank the Romanian Ministry of National Education for the financial support represented by the grant 470/1997.

2 Materials and Methods

The macro flora described in this paper was almost entirely collected by two of the authors (BARBU & CODREA) from the quarries at Bârzăviţa II and Pârâul Neamţului. The fossil plants were preserved in diatomite as well as in volcanic rocks. Unfortunately, the preservation status is rather poor, which made sometimes the study difficult. The material is stored in the Institutes of the authors.

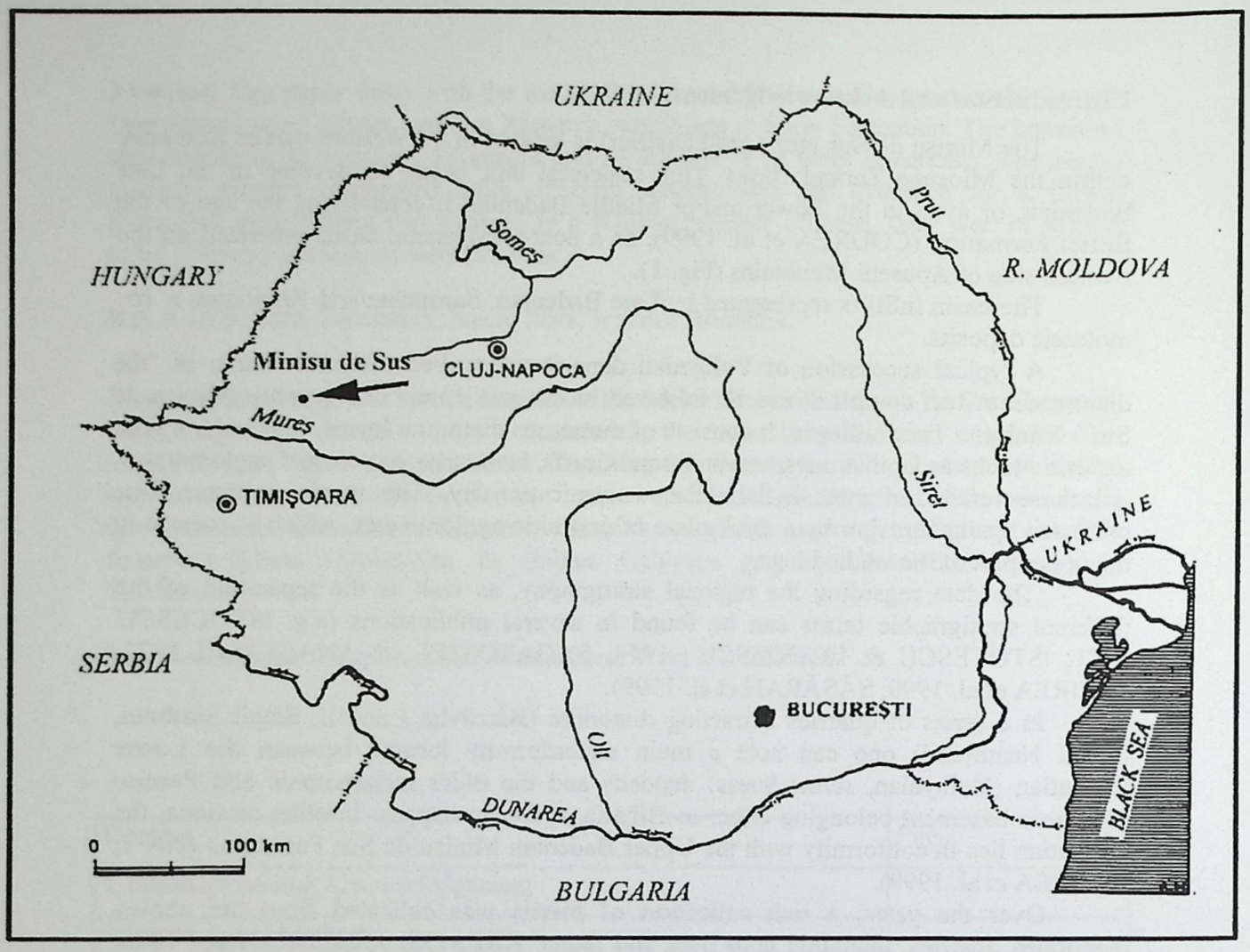


Fig. 1. Location of Minişu de Sus on the map of Romania.

3 The fossil Flora

3.1 Algae

***Cystoseirites partschi* Sternberg, 1833**

Pl. 1 figs1, 2

1833 *Cystoseirites partschi* Sternberg: Versuch: 35, Taf. 2, fig.1
1855 *Cystoseirites partschi* Sternberg, Andrae: Abh. k. k. geol. R. A.: 11, Taf. 1, fig. 4
1891 *Cystoseirites partschi* Sternberg, Staub: Foldt. kozl. 21: 354, Taf. 1
1942 *Cystoseirites partschi* Sternberg, Barbu: Bul. soc. rom. geol. 5: 124, fig.10.
1954 *Cystoseirites partschi* Sternberg, Barbu: An. Com. Geol. 27: 22, Taf. 1, figs.1-3.
1968 a *Cystoseirites partschi* Sternberg, Givulescu: Stud. şi cerc. s. geol. 13, 1: 281.
1975 a *Cystoseirites partschi* Sternberg, Givulescu: Stud. şi com. şt. nat. Muz. Bruken. 19: 71, Taf. 1, figs. 1-3, Taf. 2, fig. 6.

1982 *Cystoseirites partschi* Sternberg, Ţicleanu & Artin: D.S. Inst. Geol. Geof. 66, 3: 176.
1982 *Cystoseirites partschi* Sternberg, Ţicleanu & Givulescu: D.S. Inst. Geol. Geof. 66, 3: 117.

Description. Three fragments of talus undoubtedly belong to this brown alga. The better-preserved fragments have a thick axis from which thinner filaments are dichotomously branching. Floating vesicles can be seen on some of the axes.

Discussion. This taxon represents a characteristic fossil, widely spread in the Romanian Early Sarmatian. It was reported from Feleac, Deva, Daia-Săcădat, Racşa and Slătioara. It was also reported in deposits belonging to the same age, from Hungary to the Caucasus Mountains (GIVULESCU 1992a, ŞTEFÂRŢĂ 1997).

Fucus sp.1

Fig. 2d

Description. A fragment of thallus with a thin straight axis of a zigzag aspect. From it thinner filaments are dichtomously branching.

Biometry. Filament length 55 mm (?), secondary axis length 35 mm.

Discussion. We studied the rich material of brown algae from the plant collection of the Botanical Garden of Cluj, but we could not exactly determine if the fragment belonged to the genus *Fucus*. Under certain circumstances, the *Cystoseira* genus also presents similar filaments but its branching is very bushy which is not the case with the fossil sample we discuss.

Within *Fucus* we found a sample of *Fucus marginalis* (no author – in the collection of the Botanical Gardens, Cluj) more or less resembling our sample. However, we have not had the possibility to find out whether the taxon is recognised in the present day literature and especially what its correct name is.

Fucus sp. 2

Pl. 1, fig. 4

Description. An imprint of a slightly thicker thallus with obvious dichotomous branching. In some of the segments the branching seems to be trichotomous with sharp endings. Neither the median element nor the conceptacles can be seen.

Biometry. Length of the filaments up to 69 mm, width up to 2 mm.

Discussion. This seems to be an imprint belonging to *Fucus*. We found a *Fucus ceranoides* L. in the collection of the Botanical Gardens, Cluj, which resembles our fossil material in the manner of branching, only the median axis is also present. This plant grows on the Atlantic coast of Great Britain, in freshwater streams. It reaches seawater areas only rarely (for example at high tide).

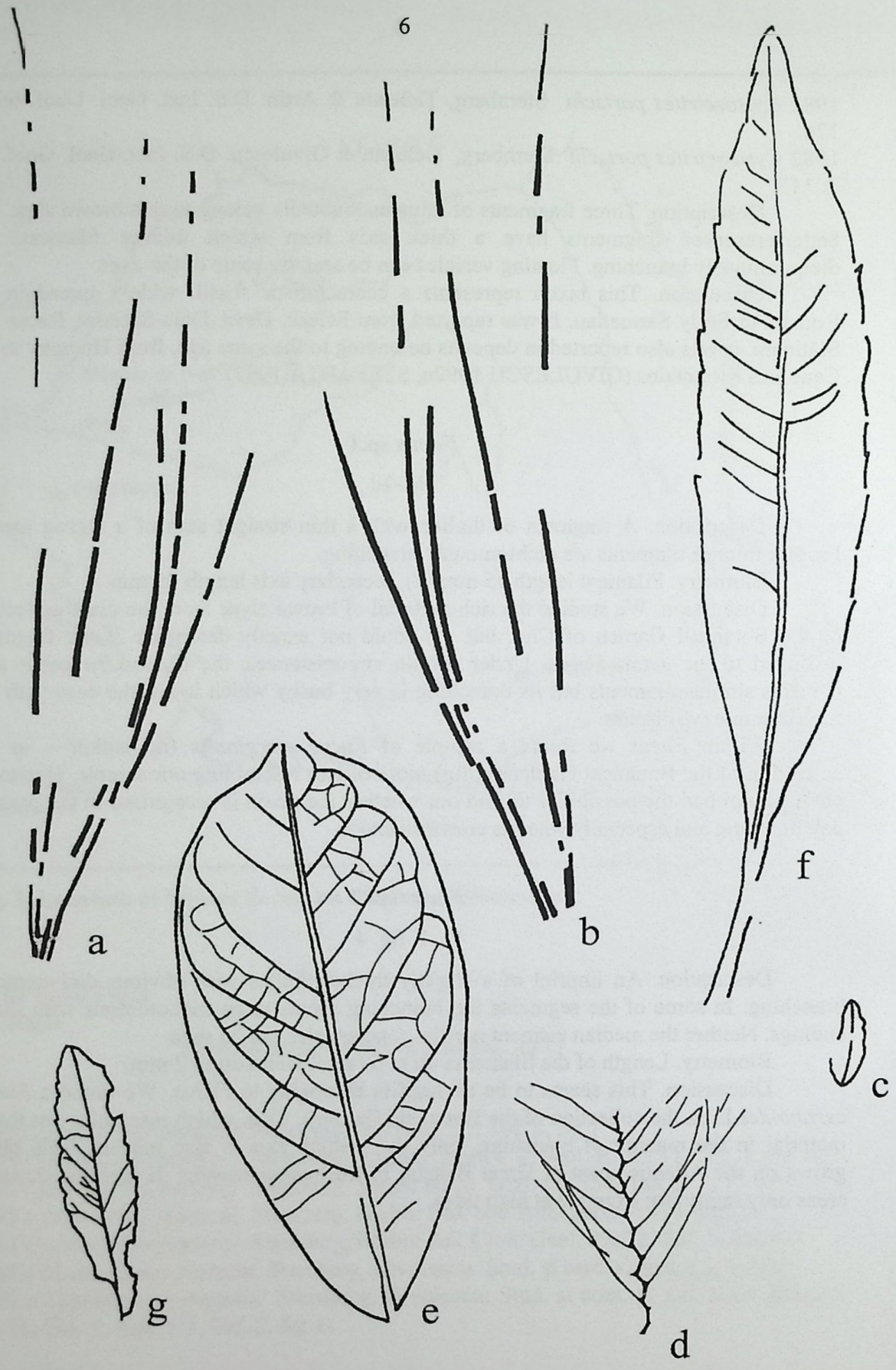


Fig. 2: a,b *Pinus* sp. ex gr. *quinae*- type 1 Beissner- impression and conpression 1x; **c.** cf. *Acacia parschlungiana* Unger 1x; **d.** *Fucus* sp. 1 1x ; **e.** *Lindera antiqua* (Heer) Givulescu, Barbu, Codrea 2x; **f.** *Myrica lignitum* (Unger) Saporta 2x; **g.** *Myrica vindobonensis* (Ettinghausen) Heer 1x

3.2 Filices

***Pteris radobojana* Unger,1852**

Pl. 1, fig. 8

1852 *Pteris radobojana* Unger: Denksch. k. Akad. Wiss. 4: 74, Taf. 4, figs. 11, 12.
1855 *Pteris radobojana* Unger, Heer: Flora tert. Helv. I: 41, Taf. 12, fig. 9.

Description. A very small fragment of pinna on which several pinnules are inserted. These are inserted perpendicularly to the axis, being attached only at their basis. The pinnule apex is rounded, the margin parallel and entire. The pinnules are 5 mm long.

Discussion. It is difficult to make a specific level assignment only based on this small fragment. However, HEER (1855; Taf. 12, fig. 5) reported material assigned to *Pteris radobojana* Unger, which is similar not only in size, but also in the disposition and pattern of pinnules.

This taxon has never been mentioned in the Romanian flora.

3.3 Gymnospermae

Fam. Taxodiaceae

***Glyptostrobus europaeus* (Brongniart, 1833) Unger, 1850**

Pl. 1, fig. 5

1833 *Taxodites europaeus* Brongniart: Ann. Sc. nat, I, 30: 168
1850 *Glyptostrobus europaeus* Unger: Sitzber. K. Akad. Wiss. math.-nat. Kl. 5: 434- 435.
1855 *Glyptostrobus europaeus* Heer: Flora tert. Helv. I.: 51, Taf. 9, 10, fig. 1.
1887 *Glyptostrobus europaeus* Brongniart, Staub: M. K. Foldt Int. evk 7: 232, Taf. 19, figs. 3, 3a, 4.
1934 *Glyptostrobus europaeus* Heer, Barbu: Acad. Rom. mem. S. st. 3, 10: 110, figs. 3, 4.
1936 *Glyptostrobus europaeus* Heer, Pop: Flora plioc. Borsec: 26, Taf. 3, fig.11, Taf. 4, figs. 1,3,4.
1957 *Glyptostrobus europaeus* Heeer, Givulescu: Flora plioc. Cornițel: 13, Taf. 1, fig. 3, Taf. 14, figs. 1, 2.
1968 *Glyptostrobus europaeus* (Brongniart) Heer, Killper: Palaeontogr. B 124: 104, Taf. 33, figs. 32, 33, Taf. 34, figs. 1- 3, Taf. 37, fig. 5.
1969 *Glyptostrobus europaeus* (Brongniart) Unger, Knobloch: Tert. Fl. Mahren: 62, Taf. 21, figs. 6, 7, Taf. 22, fig. 1, Taf. 24, figs. 1, 2, 3, Taf. 34, fig. 4, Taf. 56, fig. 1.
1969 *Glyptostrobus europaeus* (Brongniart) Unger, Givulescu & Ghiurcă: Inst. Geol. Memorii 10: 19, Taf. 6, fig. 2, Taf. 17. fig. 4.
1978 *Glyptostrobus europaeus* (Brongniart) Unger, Mai & Walther: Abh. Staatl. Mus. Min. Geol. 28: 26.
1990 *Glyptostrobus europaeus* (Brongniart) Unger, Givulescu: Flora mioc. sup. Chiuzbaia: 32, Taf. 25, figs. 1, 2, Taf. 26, fig. 14, Taf. 27, figs. 2, 3, Taf. 43, fig. 7.

1996 b *Glyptostrobus europaeus* (Brongniart) Unger, Givulescu: Flora olig. Baz. Petroşani: 21, Taf. 1, figs. 5, 6, 7.

Description. A branch fragment, with 5 female cones. The branches are made up of the characteristic scale-like leaves. The cones are ovoid, small, with fan-shaped scales and crenate in the upper part.

Biometry. Length of cones 10 mm; width 8.7 mm.

Discussion. *Glyptostrobus europaeus* is the most widely spread conifer in the Romanian Mio-Pliocene. It is especially common in the areas with coal formations

GIVULESCU (1993-1994) described in Romania this taxon from 36 sites. The oldest record originates from the Late Oligocene from Valea Jiului and the youngest, from the Dacian (Early Pliocene) of Oltenia (SW Romania). It is generally accepted that the present-day equivalent is *G. pensilis* (Stount) Koch = *G. heterophylla* Endl., a tree from the rain forest areas of the Kwantung, Kwansai and Hainan regions (SE China), as well as from Vietnam.

Fam. Pinaceae

***Pinus* sp.aff. *Pinus taedaeformis* (Unger, 1852) Heer, 1859**

Pl. 2, figs 1, 2, 6, 8

1852 *Pinites taedaeformis* Unger: Iconogr.pl.foss: 25,Taf. 12, fig. 4.
1859 *Pinus taedaeformis* Unger, Heer: Flora tert.Helv.III:160,Taf. 146, fig.10.
1936 *Pinus taedaeformis* (Unger) Heer, Pop: Flora plioc. Borsec: 36, Taf. 4, figs. 8, 9.
1960 *Pinus taedaeformis* (Unger) Heer, Givulescu: Acta Bot. Ac sc. Ung. 6, 1-2: 36.
1962 *Pinus taedaeformis* (Unger) Heer, Givulescu: Palaeontogr. B 116: 134, figs. 18, 21.
1969 *Pinus taedaeformis* (Unger) Heer, Givulescu & Ghiurcă: Inst. Geol. Geof. Mem. 10: 18, Taf. 17, fig. 2.
1977 *Pinus taedaeformis* (Unger) Heer, Istocescu & Givulescu: D. S. Inst. Geol. Geof. 63, 3: 154.
1993 *Pinus taedaeformis* (Unger) Heer, Givulescu, Petrescu, Barbu: Docum. natur. 80: 12.
1995 *Pinus taedaeformis* (Unger) Heer, Petrescu, Givulescu, Barbu: Rev. paleobiol. 14, 1: 213, Taf. 2, fig. 6.
1997 *Pinus taedaeformis* (Unger) Heer, Petrescu, Givulescu, Barbu: Macro- şi microflora oligocenă de la Corneşti-Aghireş, România: 43, Pl. I, fig. 16.

Description. A fragment of a *Pinus* leaf/short shoot with three needles emerging from a brachyblast.

Biometry. Length 67 mm, width 0.75 mm.

Discussion. We commonly assign brachyblasts with three needles to the fossil taxon *Pinus taedaeformis* Mill, although other species of *Pinus* cannot be excluded. *Pinus taedaeformis* was brought into connection with *Pinus taeda* Linné, the latter growing in the eastern parts of the United States of America, in moist low land regions.

Pinus sp.- *quaternae*

Pl. 2, fig. 5

Description. One specimen of four-needled *Pinus*, length 150 mm, width less than 0.5 mm. The needles obviously arising from a very short brachyblast, then spreading like a fan. They are very long and especially very thin.

Discussion. Four-needled *Pinus* remains are generally rare. In Romania, they have been reported only from Delureni (former Beznea; GIVULESCU 1961). These needles are up to 180 mm (?) long, but thicker (0.8-0.9 mm). The palaeobotanical literature includes only the report of ANDREANSZKY (1959) from Erdőbenye. Modern pines of the "taeda" group sometimes bear not only 3 but also 4 or even 5 needles (MORGENTHAL 1964).

Pinus sp., ex. gr. *quinae* Beissner- type 1

Pl. 2, figs 3, 4, Fig. 2 a,b

Description. A very well preserved specimen represented by a tuft of five *Pinus* needles, the length of which is approximately 180 mm (?) and width 0.50-0.75 mm. The needle leaf margin is entire.

Discussion. It is obvious that we are dealing with a pine belonging to the *Cembra* or *Strobus* (Spach) section. However, the specific affiliation of such needles is difficult. In the palaeobotanical literature one can find *P. palaeostrobus* Ettinghausen, which in SCHIMPER'S (1872) opinion would exceed 130 mm in length, but with needles 1-3 mm in width. However, this last detail does not accord with our material. POP (1936) reported from Borsec five-needled short shoots of over 105 mm in length (unquestionably shorter than ours) and 0.6-1.0 mm in width. For comparison, Pop mentioned some recent pine species, but he was not satisfied with this. Only the modern *Pinus pseudostrobus* Lindley possesses needles 170-200 mm in length, but their margin is finely serrate, consequently different from our material.

The Minişu de Sus material represents the second record of a five-needled *Pinus* from Romania, which can be assigned to this artificial Beissner group. *Pinus* cf. *strobus* Linné mentioned from Borsec (POP 1936), Valea Crişului (GIVULESCU 1962) and Chiuzbaia (GIVULESCU 1990) also has five-needled leaves. Except for the five-needled leaf pattern, the remaining characters do not have anything in common with the material described here.

Pinus sp., ex gr. *quinae Beissner-* type 2

Description. This is a fragment having five-needles that arise from a short brachyblast. The needles are 78 mm in length and 1 mm in width; they seem to have been rigid.

Discussion. These types of five-needled pines have rarely been reported in the palaeobotanical literature from Romania (GIVULESCU 1995-1996). The following examples are worth mentioning: *Pinus* sp. ex gr. *quinae* Beissner from Delureni (Pannonian) and Borsec (Romanian) and *Pinus* cf. *strobus* Linné from Porceni

(Sarmatian), Chiuzbaia (Pontian) and Valea Crişului (Pannonian). If we were to mention *Pinus strobus*, we should note that it is a North American element (found on the NE coast of the USA). It occurs in alluvial meadows or even in swampy areas (typically Great Lakes Region extending to the Allegheny Mountains).

3.4 Angiospermae - Dicotyledoneae

Fam. Lauraceae

Daphnogene polymorpha (Al. Braun, 1845) Ettingshausen, 1851

1845 *Ceanotus polymorphus* Al. Braun: Neu. Jb. Min. Geol. Palaont.: 171.
1851 *Daphnogene polymorpha* Al. Braun, Ettingshausen: Abh. k. k. geol. R. S. 2: 16, Taf. 2, figs. 23-25.
1854 *Daphnogene polymorpha* Al. Braun, Ettingshausen: Denkschr. k. Akad. wiss.: 8, Taf. 6, figs. 1-4, Taf. 7, fig. 2.
1856 *Cinnamomum polymorphum* Al. Braun, Heer: Flora tert. Helv. II: 88, Taf. 43, figs. 25-28, Taf. 44, figs. 1-26.
1951 *Cinnamomum polymorphum* Al. Braun, Givulescu: Studii şi cerc. Acad. Cluj 2, 1-2: 113.
1957 *Cinnamomum polymorphum* Al. Braun, Givulescu: Flora plioc. Cornițel: 57, Taf. 7, figs. 3, 4.
1968 b *Cinnamomophyllum polymorphum* Al. Braun, Givulescu: Geologie 17, 5: 577, Taf. 2, fig. 8, Taf. 3, figs. 1, 2.
1974 *Daphnogene bilinica* (Unger) Kvacek & Knobloch, Givulescu: Cont. bot.: 230, Taf. 4, fig. 4.
1978 *Daphnogene cinnamomifolia* (Bongniart) Bronn, Ţicleanu & Givulescu: Cour. Forsh. Inst. Senkb. 30: 141, Taf. 8, figs. 13, 15.
1990 *Daphnogene polymorpha* (Al. Braun) Ettingshausen, Givulescu: Flora mioc. sup. Chiuzbaia: 45, Taf. 3, fig. 5, Taf. 11, fig. 3.

Description. A single very well preserved leaf. It is ovate with a normal acute base and acute apex. The margin is entire. The texture cannot be defined very well, but it was most probably coriaceous. The venation is acrodromous suprabasal imperfect, the two primary lateral veins arising from the same point and having, at least one of them, a gland at the point of emergence. Their trajectory is curved towards the lamina margin; they end in the upper second third.

Biometry. Length 58 mm, width 23 mm, height of the maximum width 20 mm, l/w 2.52, h/l 34.48 %.

Discussion. *Daphnogene polymorpha* is the typical taxon for the Miocene. In Romania it extends at least to the Late Pliocene and even up to the Early Pleistocene, as a relict (GIVULESCU 1997a, 1997c). It has been reported from numerous Miocene sites.

Lindera antiqua (Heer, 1856) Givulescu, Barbu, Codrea, 1995

Fig.2 d

1856 *Benzoin antiquum* Heer: Flora tert. Helv. II: 81, Taf. 90, figs. 1-8.
1954 *Benzoin antiquum* Heer, Givulescu: Comun. Acad. R.P.R. 4, 11- 12: 645
1993 *Benzoin antiquum* Heer, Givulescu: Studia Univ. Babeş-Bolyai, geol. 38, 2: 23.
1995 *Lindera antiqua* (Heer) Givulescu, Barbu, Codrea: Studia Univ. Babeş-Bolyai, geol. 40, 2: 66.

Description. Entire, well preserved obovate leaf, acuminate apex, normal acute base and entire margin. Its texture is coriaceous. The venation is pinnate camptodromous, eucamptodromous with a straight primary vein tapering towards the apex, with rare and fine secondary veins disposed alternately and irregularly and a straight or slightly curved course. The secondaries arise at moderately acute angles with intersecondary veins present. The tertiary veins form an orthogonal reticulate network.

Biometry. Length 54 mm, width 22 mm, height of the maximum width 33 mm, A 5 mm, I-I' 11 mm, l/w 2.45, h/l 61.11 %, A/l 9,25 %, α– 80^0 , β– 44^0–50^0 , S 11.88 sq. cm- microphyll.

Discussion. This leaf is unquestionably a Lauraceae, most of all resembling the type described by Heer as *Benzoin antiqum*. It is a rarely quoted taxon. As for Romania, we know it from the Pannonian at Vadu-Crişului (GIVULESCU 1993). Its present day correspondent should be looked for among the modern *Lindera* taxa, either *L. benzoin* = *Benzoin aestivale* or, according to Heer, *B. odoriferum*. Both are synonymous and grow in the United States (as 1-3 m high shrubs growing in Ontario, Michigan, and as far as North Carolina, Tennessee, on riverbanks or in swampy biotopes in various assemblages of the "Deciduous Forest Formation").

Laurophyllum cf. *braunii* (Heer, 1856) Nemejc & Knobloch, 1973

1856 *Persea braunii* Heer: Flora tert. Helv.II : 80, Taf. 89, figs. 9, 10.
1935 *Persea braunii* Heer: Stefanoff & Jordanoff: Sb. Acad. Sc. Bulg. 29: 49, Taf.17, figs. 4-5, fig. text 46.
1953 *Persea speciosa* Heer: Berger & Zabusch: N.Jb. Geol. Palaont. 98, 2: 43, Taf. 16, fig. 239.
1973 *Laurophyllum* cf. *braunii* (Heer) Nemejc & Knobloch: Chronostr. Neostrat. Miozän, M_2-Ottnang., Bd. III: 708, Taf. 3, fig. 4, Taf. 6, figs. 1- 5, Taf. 7, fig. 5, Taf. 9, fig. 5, Taf. 10, figs. 4, 5, 8.
1990 *Laurophyllum braunii* (Heer) Nemejc & Knobloch., Givulescu: Flora mioc. sup. Chiuzbaia: 43, Taf. 7, fig. 6, Taf. 23, fig. 1.
1996b *Laurophyllum braunii* (Heer) Nemejc & Knobloch., Givulescu: Flora olig. sup. Baz. Petroşani: 33, Taf. 7, fig. 8.
1997 *Laurophyllum braunii* (Heer) Nemejc & Knobloch., Petrescu, Givulescu, Barbu: Macro- şi microflora oligocenă de la Corneşti-Aghireş, România: 49, Pl. III, fig. 12, Pl. V, fig. 3.

Description. A well-preserved leaf without apex. Lamina elliptic, base normal acute and margin entire. The texture cannot be identified. Venation camptodromous, eucamptodromous with an obvious primary vein, not very thick, and a relatively small number of secondary veins that are thinner, subopposite, curved, parallel and with a moderate to acute angle of emergence.

Biometry. Length 50 (?) mm, width 32 mm, height of the maximum width 28 mm.

Discussion. *Laurophyllum braunii*, the former *Persea braunii* of Heer, is also a typical taxon of the Miocene, but it was also found at Corneşti-Aghireş (Late Oligocene) (PETRESCU et al. 1997). However, it does not occur beyond the Late Pontian at Chiuzbaia (GIVULESCU 1990). In our country, it is a taxon commonly found in Transylvania, mainly in the Late Miocene of the Vad-Borod Basin (Western Romania).

Laurophyllum ? sp.

Description. A narrow elliptical leaf with an entire margin probably acute apex and normal acute base. Texture is unknown. The venation seems to be of the pinnate type (camptodromous, eucamptodromous) with a thin primary vein and several very thin arched secondary veins. Their angle of emergence is tapering along the lamina edge for a considerable length.

Discussion. The leaf is not very well preserved, so certain delimitation is not possible. However, it is highly probable that it is a form between the very diverse Miocene Lauraceae.

Fam. Platanaceae

Platanus leucophylla (Unger, 1840) Knobloch, 1971

1840 *Populus leucophylla* Unger: Gen. et spec. plant. fossil.: 1- 550.
1852 *Platanus platanifolia* Ettingshausen: Abh. K.-K. geol. R. A. : 7, Taf. 1, fig. 13.
1855 *Quercus platanifolia* Goeppert: Tert Fl. Schossnitz: 16, Taf. 1, fig. 6.
1855 *Platanus aceroides* Goeppert: Tert Fl. Schossnitz: 21, Taf. 9, figs.1- 3, 4- 6.
1856 *Platanus aceroides* Goeppert, Heer: Flora tert. Helv. II: 71, Taf. 88, fig. 15.
1864 *Platanus aceroides* Goeppert, Ettingshausen: Denkschr. K. Akad. Wiss.math-naturwiss Kl. 26: 24, Taf. 29, fig. 7.
1872 *Platanus aceroides* Goeppert, Schimper: Traite III: 706.
1957 *Platanus aceroides* Goeppert, Givulescu: Flora plioc. Cornițel: 60, Taf. 9, figs. 4, 5.
1969 *Platanus platanifolia* (Ettingshausen), Knobloch: Tert. Flora. Mahren: 97, Taf. 46, fig.2, Taf. 47, figs. 1- 8, Taf. 48, figs. 1-5, Taf. 49, figs. 1, 2, 5, fig. text 19:4.
1971 *Platanus leucophylla* (Unger) Knobloch: Berichtigungen zur miozänen Flora der Rhon mit Bemerkungen zur Alterstellung. Mitt. Bayer St.-Samml. Paläont. hist. Geol., 11: 256.
1973 *Platanus platanifolia* (Ettingshausen) Knobloch, Givulescu, Olos: Inst. Geol. Geof. Mem. 19: 19, Taf. 7, fig. 15.
1982 a *Platanus platanifolia* (Ettingshausen) Knobloch, Givulescu: D. S. Inst. Geol. Geof. 66, 3: 134, Taf. 1, fig. 1.

1990 *Platanus platanifolia* (Ettingshausen) Knobloch., Givulescu: Flora mioc. sup. Chiuzbaia: 54, Taf. 21, fig. 6.
1996 b *Platanus leucophylla* (Unger) Knobloch., Givulescu: Flora olig. sup. Baz. Petroşani: 43.

Description. The leaf, 60 mm (?) in length, with venation actinodromous. Secondary veins develop from the main venation on the lower side of the leaf. Characteristic teeth can be distinguished on the leaf margin.

Discussion. Therefore, we are dealing with a *Platanus* leaf. The marginal tooth and the venation type strongly suggest it. *Platanus leucophylla* is a typical taxon for the Miocene, with a wide European distribution. In Romania it was described under some older names, such as *Platanus aceroides* and *Platanus platanifolia,* from numerous - not less than 19 - Lower Oligocene-Upper Pontian sites, distributed on the whole Romanian territory (GIVULESCU 1997b). Both citations, from the Early Oligocene as well as the one from the Late Pontian, can be considered as exceptions, these taxa being typical for the Miocene, more precisely for the Badenian-Pannonian timespan.

An actual related species is *P. occidentalis* Linné. This is an over 25 m high tree, growing in the United States of America, in mesophytic forests. Its favourite areas are alluvial valleys and even swampy environments.

Fam. Fagaceae

***Quercus* cf. *ilex* Linné, 1753**

1753 *Quercus ilex* Linné: Spec. plant.: 995.
1936 *Quercus* cf. *ilex* Linné, Pop: Flora plioc. Borsec: 71, Taf. 17, figs. 4-7, Taf. 2, fig. 4, Taf. 3, fig. 5?.
1951 *Quercus* cf. *ilex* Linné, Givulescu: Studii şi cerc. st. Acad. Cluj 2, 1-2: 110.
1957 *Quercus* cf. *ilex* Linné, Givulescu: Flora plioc. Cornițel: 42, Taf. 4, fig. 7, Taf. 5, fig. 4.
1962 *Quercus* cf. *ilex* Linné, Givulescu: Palaeontogr. B 110, 5-6: 143, figs. 78-80, 241.
1966 *Quercus* cf. *ilex* Linné, Maxim & Petrescu: Studia Univ. Babeş-Bolyai, geol.-geograph., 2: 122.
1975 b *Quercus* cf. *ilex* Linné, Givulescu: Palaeontogr. B 153, 4-6: 153, fig. 2.
1978 *Quercus* cf. *ilex* Linné, Şuraru, Şuraru, Givulescu: Nymphaea 6: 75.

Description. An almost complete imprint of a slightly asymmetrical elliptic leaf with an acute base, apex not preserved. The margin is characteristically asymmetrically dentate, however, the dentation is restricted to the lower third of the lamina. The tooth sinus is rounded and slightly deepened. The external side of the tooth is long, almost straight, vaguely resembling an S-shape whereas the inner side is very short and straight. The texture cannot be identified. The petiole is normal, 20 mm in length. Its venation is pinnate craspedodromous, characterised by its thickness. Secondary veins are rare, more or less straight, opposite or subopposite, one vein corresponding to each tooth.

Biometry. Length 47 mm (?), width 23 mm, height at the site of maximum width 28 mm.

Discussion. *Quercus* cf. *ilex* was a widely spread taxon in Romania during the Early Sarmatian-Pannonian (Cornițel, Luncşoara, Valea Neagră; GIVULESCU 1997b) and Dacian (Borsec; POP 1936).

The present day corresponding taxon, a small tree, can be found around the Mediterranean Sea.

Quercus sp. or *Castanea* sp.

Description. A basal fragment of a leaf, that seems to be semicoriaceous. Leaf with a normal acute base and a dentate margin with sharp teeth, oriented parallel to the leaf margin, with a shallow, somewhat rounded, sinus. Only the primary vein is visible.

Discussion. These features remind us of the genera *Quercus* and *Castanea.* A more accurate determination is not possible.

Fam. Myricaceae

Myrica lignitum (Unger, 1847) Saporta, 1865

Pl. 2, fig. 7; Fig. 2 f

1847 *Quercus lignitum* Unger: Chloris protog. IV: 113, Taf. 31, figs. 5, 7.
1851 *Dryandroides lignitum* Ettingshausen: Abh. k. k. Geol. R. A. 2: 33, Taf. 5, figs. 3-5.
1856 *Dryandroides lignitum* Heer: Flora tert. Helv. II: 109, Taf. 99, figs. 9-11.
1865 *Myrica lignitum* (Unger) Saporta: Ann. sc. nat. 4: 102, Taf. 5, fig. 10.
1936 *Myrica lignitum* (Unger) Saporta, Pop: Flora plioc. Borsec: 45, Taf. 12, figs. 4, 5.
1957 a *Myrica lignitum* (Unger) Saporta, Givulescu: Flora plioc. Cornițel: 27, Taf. 2, fig. 8.
1961 *Myrica lignitum* (Unger) Saporta, Knobloch: Sb. ustr. ust. geol. 26: 256, Taf. 1, fig. 8, Taf. 2, fig. 10, Taf. 3, fig. 3.
1963 *Myrica lignitum* (Unger) Saporta, Jung: Palaeontogr. B 112: 127, Taf. 33, fig. 10.
1964 *Myrica lignitum* (Unger) Saporta, Kolakovski: Pliots. Flora Kodora: 120, Taf. 46, figs.2-10.
1973 *Myrica lignitum* (Unger) Saporta, Givulescu, Olos: Inst. Geol. Geof. Mem. 19: 13, Taf. 5, figs. 2-9.
1975 *Myrica lignitum* (Unger) Saporta, Stancu & Țicleanu: D. S. Inst. Geol. Geof. 61, 3: 193, Taf. 2 fig. 2, fig. text 36.
1975 *Myrica lignitum* (Unger) Saporta, Givulescu: Muz. Bruk. Studii şi comun. 19: 73.
1976 *Myrica lignitum* (Unger) Saporta, Knobloch & Kvacek: Rozpr. ustr. ust. geol. 42: 20, Taf. 6, figs. 2-4, Taf. 7, fig. 6, Taf. 8, figs. 1-7, fig. text 6.
1983 *Myrica lignitum* (Unger) Saporta, Hummel: Pr. Muz. Ziemi 36: 17, Taf. 3, figs. 1-3a, Taf. 4, figs. 1-5, fig.text 5.
1996 b *Myrica lignitum* (Unger) Saporta, Givulescu: Flora olig. sup. Baz. Petroşani: 58, Taf. 2, figs. 1, 5.

Description. A well-preserved narrow-elliptic leaf with an acute apex and a narrow, normally acute base. The margin is sparsely denticulate; an external short concave side margin can be noted along with a rounded, slightly deeper sinus. The leaf texture is coriaceous, the petiole is 14 mm. long. Only the mid vein is discernable, which becomes thinner towards the tip and to a doubtful secondary vein the course of which cannot be followed.

Biometry. Length 75 mm, width 15 mm, height of the maximum width 37 mm, A 18 mm, I-I' 11 mm, l/w 5, h/l 49.33 %, A/l 25 %, α– 28^0, S 7.5 sq. cm- microphyll.

Discussion. *Myrica lignitum* is one of the most widespread fossil taxon in the European Miocene. It is also known from the Late Oligocene and it may be regarded as a relict in the Pliocene (POP 1936). In Romania, *Myrica lignitum* is very widespread from Dacian at Baraolt (Harghita) to Early Oligocene at Coaş (Maramureş; GIVULESCU 1997c).

Its present day equivalent is unanimously considered to be *Myrica cerifera* Linné. a shrub (0.5-1.5 m) in the East of the USA from Maryland to the South of Florida (wet, swampy areas). Now, *Myrica lignitum* may be regarded as a "Sammeltype", but since there is no study on the respective taxon we have to use its old name.

Myrica vindobonensis (Ettinghausen, 1851) Heer, 1856

Pl. 1, fig. 3, Pl. 3, fig. 4, Fig.2g

1851 *Dryandroides vindobonensis* Ettingshausen: Abh. k. k. geol. R. A. I: 18, Taf. 3, fig. 6

1856 *Myrica vindobonensis* Ettingshausen, Heer: Flora tert. Helv. II: 34, Taf. 70, figs. 5-6, III: 176, Taf. 150, figs. 16, 17

1869 *Myrica vindobonesis* (Ettingshausen) Heer: Mioc. Balt. Flora 32, Taf. 7, figs. 3 a, 4-10,

1964 *Myrica vindobonensis* (Ettingshausen) Heer, Budantsev & Sveshnikova: Palaeobot. 5: 97, Taf. 8, figs. 1-3

1997 *Myrica vindobonensis* (Ettingshausen) Heer, Petrescu, Givulescu, Barbu: Macro- şi microflora oligocenă de la Corneşti-Aghireş, România: 64, Pl. II, fig. 11, 12, Pl. XXXI, fig. 8

Description. A well-preserved leaf, with a narrowly elliptical shape, a normal acute base and an irregular and coarsely toothed margin, with broad triangular or more attenuate teeth. The apex is missing, but was probably acute. Membranaceous texture. Craspedodromous venation, with a thick primary vein, thin secondary ones approximately straight, parallel, arising at a moderate acute angle.

Biometry. Length 50 mm (complete), width 13.0 mm, height of the maximum width 26.0 mm, l/w 1.92, h/l 52 %, S 4.33 sq. cm- microphyll.

Discussions. This taxon represents a rarity in the European flora. It has been very rarely mentioned in the Neogene from the Vienna Basin (ETTINGSHAUSEN 1851), the Badenian-Sarmatian from Oehningen (HEER 1856), the Pannonian from Hust-Mukacevo (ILJINSKAIA 1968b) and even in the Oligocene from Kaliningrad (HEER 1869). In

Romania it has been recorded only in the Oligocene at the Rupelian/Chattian boundary at Corneşti-Aghireş, near Cluj-Napoca (PETRESCU et al. 1997).

As for its resemblance with a present day taxon, we consider that it could be compared with *M. conifera* Brum. = *M. aethiopica* L.= *M. serrata* Lam. (see figures in WALTHER 1964, Taf.13, figs. 2, 3).

Fam. Juglandaceae

***Carya denticulata* (Weber, 1852) Iljinskaia, 1964**

1852 *Juglans denticulata* Weber: Palaeontogr. 2: 211, Taf. 23, fig. 10.
1852 *Pavia septimontana* Weber: Palaeontogr. 2: 200, Taf. 22, fig. 11.
1859 *Pterocarya denticulata* (Weber) Heer: Flora tert. Helv. III: 94, Taf. 131, figs. 5-7.
1876 *Juglans minor* Saporta & Marion: Arch. Mus. Hist. Nat. Lyon 1: 166, Taf. 32, figs. 1-8.
1903 *Carya minor* Saporta & Marion, Marty: Rev. Haute Auverge 5: 58, Taf. 12, figs. 1-8.
1936 *Carya minor* (Saporta & Marion) Marty, Pop: Flora plioc. Borsec: 46, Taf. 1, fig. 19, Taf. 5, figs. 7, 8, Taf. 12, fig. 6.
1957 *Pterocarya denticulata* (Weber) Heer, Givulescu: Flora plioc. Cornițel: 29, Taf. 15, fig. 3.
1963 *Pterocarya denticulata* (Weber) Heer, Jung: Palaeontogr. B 112: 135, Taf. 34, figs. 13, 14, Taf. 35, figs. 22, 23.
1964 *Carya denticulata* (Weber) Iljinskaia in Kolakovski: Pliots. Flora Kodora: 95, Taf. 36, figs.3-6.
1965 *Carya denticulata* (Weber) Iljinskaia, Kryshtofovici & Baikovskaia: Sarm. Flora Krinki: 27, Taf. 1, figs. 8, 9, Taf. 2, figs. 5, 6, Taf. 3, figs. 1, 2a, Taf. 4, figs, 1-3, Taf. 7, figs. 1-3.
1965 *Carya denticulata* (Weber) Iljinskaia, Hantke: Zur. Natf. Ges. 167: 37, Taf. 5, figs.1,2,7,8.
1969 *Carya minor* Saporta & Marion, Givulescu & Ghiurcă: Inst. Geol. Mem. 10: 40, Taf. 3, fig. 3, Taf. 10, fig. 4, Taf. 12, figs. 1-3, 7.
1979 *Carya minor* Saporta & Marion, Givulescu: Inst. Geol. Mem. 28: 77, Taf. 10, figs. 4-6, Taf. 26, fig. 4, Taf. 34, figs. 10, 11, Taf. 41, fig. 13.
1990 *Carya denticulata* (Weber) Iljinskaia, Givulescu: Flora mioc. sup. Chiuzbaia: 102, Taf. 17, figs. 5, 8, 15, Taf. 21, fig. 7, Taf. 29, fig. 5.
1996 b *Carya denticulata* (Weber) Iljinskaia, Givulescu: Flora olig. sup. Baz. Petroşani: 60, Taf. 3, figs. 6, 7, Taf. 23, fig. 4.

Description. A large, well preserved foliole, ovate in shape, slightly asymmetrical, with an acute apex and a normal acute and symmetrical base. The margin is dentate (large teeth relatively regularly placed). The texture is membranaceous. The petiole is short. The venation is of semicraspedodromous type. The primary vein is prominent, curved, whereas the secondary venation is subopposite parallel and with a large acute angle of

emergence. It is anastomosed close to the lamina margin, only the third order veins penetrating into the margin teeth.

Biometry. Length 92 mm, width 45 mm, height of the maximum width 30 mm, l/w 2.04, h/l 32.6 %, S 27.61 sq. cm- notophyll.

Discussion. *Carya denticulata* is a taxon oddly distributed in the fossil flora of Romania. It occurs between Late Oligocene-Burdigalian (Surduc, Valea Jiului, Coruş, Tihău) and Late Pontian-Early Pleistocene (the Oaş Basin, Chiuzbaia- more than elsewhere, Borsec and Bodoş). We should, therefore, mention the fact that this is the first report in the Early Sarmatian from Romania.

The present day equivalent is not enough clear: it is *Carya tomentosa, C. amara* or *C. ovata*, all trees growing in the riverside localities in the SE of the USA.

Fam. Mimosaceae

cf. *Acacia parschlugiana* Unger, 1840

Pl. 3, fig. 3, Fig. 2 c

1840 *Acacia parschlugiana* Unger: Gen et spec. plant. fossil.: 494.
1853 *Acacia parschlugiana* Unger, Ettingshausen: Sitz. ber. Akad. Wiss. Wien 11: 39, Taf. 4, fig. 8.
1859 *Acacia parschlugiana* Unger, Heer: Flora tert. Helv. III: 130, Taf. 139, figs. 45- 49.
1859 *Acacia oeningensis* Heer: Flora tert. Helv. III: 131, Taf. 139, fig. 44.
1959 *Acacia parschlugiana* Unger, Andreanszky: Sarm. Flora Ungarns: 144, fig. text 157.
1997 *Acacia parschlugiana* Unger, Petrescu, Givulescu, Barbu: Macro- şi microflora oligocenă de la Corneşti-Aghireş, România: 70, Pl. IX, fig. 15- 20, Pl. XXIII, fig. 4, Pl. XXXII, fig. 6.

Description. Only one well preserved foliole. It is narrow, obovate, with an acute apex, an asymmetrical normal acute base and entire margin. The foliole is sessile. The texture cannot be specified. Only a thick primary vein can be distinguished.

Biometry. Length 20 mm, width 6 mm, S 0.80 sq. cm- nannophyll.

Discussion. The enumerated features are very similar to those of *A. parschlugiana*, with a rare distribution through the Oligocene and Miocene. In Romania it has been mentioned only from the Pannonian B/C, at Valea Crişului (GIVULESCU 1962) and from the Oligocene at Corneşti-Aghireş (GIVULESCU et al. 1993). The true taxonomic status of these folioles remains unclear.

Fam. Caesalpiniaceae

***Cassiophyllum berenices* (Unger, 1850) Kräusel, 1938**

Pl. 1, fig. 7

1850 *Cassia berenices* Unger: Denkschr. k. Akad. Wiss. 2: 57, Taf. 43, figs. 4-10.
1859 *Cassia berenices* Unger, Heer: Flora tert. Helv. III: 118, Taf.136, figs. 42-56.

1874 *Cassia berenices* Unger, Schimper: Traite III: 388, Taf. 105, figs. 19, 20.
1877 *Cassia berenices* Unger, Ettingshausen: Denkschr. k. Akad. Wiss. 37: 165, Taf. 20, figs. 31-34.
1938 *Cassiopyllum berenices* (Unger) Kräusel: Palaeont. Zt. 29: 66, Taf. 9, fig. 10, fig. text 20 e.
1954 *Cassiophyllum berenices* Unger, Pimenova: Sarmatsk. fl. Amvros.: 73, fig. text 62.
1975 c *Cassiophyllum berenices* (Unger) Kräusel, Givulescu: Inst.Geol. Mem.22: 65, Taf. 4, fig.4.
1979 *Cassiophyllum berenices* (Unger) Kräusel, Givulescu: Inst. Geol. Mem. 28: 102, Taf. 42, figs. 2-10.
1983 *Cassiophyllum berenices* (Unger) Kräusel, Givulescu: Acta palaeobot. 23, 1: 83, fig.1-1.
1986 *Cassiophyllum berenices* (Unger) Kräusel, Petrescu & Givulescu: Rev paleobiol. 5, 1: 110.
1996 b *Cassiophyllum berenices* (Unger) Kräusel, Givulescu: Flora olig. sup. Baz. Petroşani: 64, Taf. 2, fig. 10.
1997 *Cassiophyllum berenices* (Unger) Kräusel, Petrescu, Givulescu, Barbu: Macro- şi microflora oligocenă de la Corneşti-Aghireş, România: 72, Pl.III, fig.13,15, Pl.XXXI, fig.3, 10.

Description. One leaflet, whose apex is missing, lamina oblong with a rounded base and an entire margin. The petiole is short and thick. The texture cannot be identified. Apart from a strong primary vein, no other venation detail can be distinguished.

Discussion. *Cassiophyllum berenices* is a poorly known taxon that can be found throughout the whole Romanian Tertiary, even if with occasional hiatuses. It has been reported from the Early Oligocene/Late Oligocene boundary (Corneşti-Aghireş), the Late Oligocene-Burdigalian (Cliţ, Valea Jiului, Tihău,), then the Early Sarmatian up to Dacian (Tâmpa, Luncşoara, Gheghie, Valea Crişului, Cornițel, Delureni, Baraolt, Sinersig, Chiuzbaia, Borsec, Şoimari; GIVULESCU 1997b).

No present day equivalent is known. However, according to its foliar morphology it can be related to the tropical genus *Cassia*.

Gleditsia lyelliana (Heer, 1859) Hantke, 1980

Pl. 1, fig. 6

1859 *Podogonium lyellianum* Heer: Flora tert. Helv. III: 117, Taf. 136, figs. 22-52.
1962 *Podogonium lyellianum* Heer, Givulescu: Palaeontogr. B 110: 152, figs. 127, 128.
1975 a *Podogonium lyellianum* Heer, Givulescu: Studii şi cerc. st. Muz. Bruk. 19: 74, Taf. 2, fig.4, Taf. 4, fig. 3.
1980 *Gleditsia lyelliana* (Heer), Gregor & Hantke: Fedd. Rep. 91, 3: 167, fig.text 7.
1982 *Podogonium lyellianum* Heer, Ţicleanu & Artin: D. S. Inst. Geol. Geof. 67, 3: 180, Taf. 3, fig. 2.

Description. Only one perfectly preserved foliole bearing all the characteristics of shape and venation described by HEER (1859). One narrow oblong foliole, with short mucronate apex, normal acute base and entire margin. Membranaceous texture, very short and stout and swollen petiole. Venation pinnate camptodromous, with a fine primary vein and numerous very fine secondary veins, regularly and parallelly placed, with an acute angle of emergence. There is a single exception, an odd vein emerging from the base, which is longer than the others and placed at a narrowly acute angle.

Biometry. Length 15.5 mm, width 5.2 mm, l/w 2.9, S 0.53 sq. cm- nannophyll.

Discussion. In fact, we have to deal with the well-known, widespread *Podogonium lyellianum* Heer, a taxon reconsidered by GREGOR & HANTKE (1980) and assigned, much more logically, to the genus *Gleditsia* Linné. In certain obsolete works, meaning especially those of ANDREANSZKY (1959), BERGER & ZABUSCH (1953), *Podogonium* was indeed considered to represent a tropical plant indicative of a strong dry climate, which is not consistent with the other representatives of the assemblage. On the contrary, the *Gleditsia* genus with its two present day species, *G. aquatica* Marsh. from the U.S.A. and *Gleditsia heterophylla* Bunge from China, does not surpass the usual limits of a subtropical climate. Researchers also related *Gleditsia lyelliana* with *G. aquatica* from the U.S.A. In fact, we have a tree which grows in the SE of the U.S.A., *i.e.* in the Gulf States (Texas and Florida) and also along the valleys of both the Mississippi and the Missouri, a tree related to moist biotopes, even wet moorland, or to temporarily flooded areas, occurring in an assemblage of trees and shrubs. It is worth mentioning that it might also occur in swamps along with *Taxodium, Nyssa* and *Carya.* We quote, after GREGOR & HANTKE (1980), some climate data: annual average temperature in the spreading area of distribution from the SE of the United States ranges from 13.5^0 to 20.5^0 C, and the annual average rainfall from 1,004 to 1,577 mm.

The above-mentioned authors even tried a reconstruction of these data for the Miocene from Central Europe. Thus we have: temperatures of 18^0-13^0 C and rainfall of approximately 1,000-1,500 mm/year. We would also like to show that one of the shrubs is part of the assemblage which includes *Gleditsia* is *Zanthoxylon*, also recorded from the deposit at Minişu de Sus. The authors have read HERENDEEN'S paper (1992), but they do not agree with his conclusions since this type of *Gleditsia* perfectly corresponds to the Minişu de Sus palaeobiotope.

Fam. Rutaceae

***Zanthoxylon europaeum* Unger, 1847**

Pl. 3, fig. 2

1847 *Zanthoxylon europaeum* Unger: Chlor. prtog. 4- 5: 89, Taf. 23, figs. 2-4.
1853 *Weinmannia microphylla* Ettingshausen: Abh. k. geol. R. A. 2: 66, Taf. 23, figs. 8-29.
1883 *Weinmannia europaea* (Unger), Heer: Flora foss. arctica 7: 120, Taf. 84, fig. 8.
1938 *Weinmannia europaea* (Unger), Heer, Kräusel: Paläont. B. 20, 1: 60, Taf. 9, figs. 1-7.
1959 *Weinmannia europaea* (Unger), Heer, Andreanszky: Sarm. Flora Ung.: 138.

1986 *Zanthoxylon europaeum* Unger, Givulescu & Rüffle: Doc. natur. 33: 47, Taf. 3, figs. 1-3.

Description. Two well-preserved leaves. They are compound oddly pinnate leaves with small folioles inserted on an axis, which has lateral winglets among the folioles. The folioles are obovate with rounded apex and acutely cuneate base. The foliole margin is crenate, but only in the upper part. The folioles are sessile and membranaceous. There is only one strong primary vein, which is slightly thickened at its base.

Biometry. Axis length 45 (?) mm and 55 (?) mm.; foliole lengths 15, 13, 12, 17, 14 mm; foliole widths - 7-8 mm.

Discussion. Although UNGER (1847) described his material under the name *Zanthoxylon europaeum*, other authors (and we mainly refer to ETTINGSHAUSEN (1853) later included it in the genus *Weinmannia*. Numerous palaeobotanists, such as KRÄUSEL (1938) and ANDREANSZKY (1959), considered it as such, although the material has nothing to do with this South American Neotropical genus of the Andes. GIVULESCU & RÜFFLE (1986) showed that these leaves do not belong to the Cunnoniaceae family but rather to the Rutaceae from the Holarctic region. The material has been reported several times under the name *Weinmannia* in different places in Europe, under the name *Zanthoxylon* it was reported for the first time by GIVULESCU & RÜFFLE (1986).

3.5 Angiospermae – Monocotyledoneae

Fam. Arecaceae

Chamaerops humilis Linné, 1753 *fossilis* Kolakovski, 1964

Pl. 3, fig. 1

1753 *Chamaerops humilis* Linné: Spec. plant.:1187
1964 *Chamaerops humilis* Linné *fossilis* Kolakovski: Pliot. flora Kodora: 34, Taf. 5, fig. 1.
1978 *Chamaerops humilis* Linné, Velitzelos, Schneider: Jung. Pflanzen. Vegora.: 796, Taf. 1.
1999 *Chamaerops humilis* Linné *fossilis* Kolakovski, Givulescu & Barbu: Eine fossile Palme Mioz. Rum.: 87-90, Taf.1.

Description. A simple basal part of a palmate leaf. The petiole is not preserved, however, there are 24 foliar rays arising from a thickening, which seems to be hemispherical. The rays are radially placed. Although very narrow at the base, they become broader in the form of a fan. It can be noted, on the one hand, that the foliar rays appear to be puckered giving the impression that they are connected to each other; on the other hand the transverse profile resembles an inverted "V" shape. In other words, the foliar ray has a strong median crest on its whole length. The venationremains unclear.

Biometry. Length 115 mm (?), width at the distal end - 12-15 mm.

Discussion. *Chamaerops* represents a palaeotropical element. At the same time, it represents a typical taxon of the Miocene reaching the present day era in relict form. It is not very widespread in the Tertiary formations of Europe. Some of the species mentioned are the following: *Ch. helvetica* from Oehningen, Badenian-Sarmatian; *Ch. kutschinica* from Kutsclin (the Czech Republic), Late Eocene; *Ch. celasensis* Laur. from Celas, Oligocene; *Ch. ligustrina* (Squin.) Princ (Italy), Pliocene; *Ch. georgica* Usu (Georgia), Oligocene; *Ch. h. fossilis* (Abkhazia), Pliocene; *Ch.h.f.* Bursuc (Moldova), the Middle Sarmatian (GIVULESCU & BARBU 1999).

The present day equivalent is *Chamaerops humilis*, a palm growing in areas of the West Mediterranean Sea at similar altitudes to *Quercus ilex*. As opposed to *Sabal*, which is the palm of moist areas, *Chamaerops* is a palm growing in dry regions with rainy winters and dry summers.

3.6 Incertae sedis

***Dicotylophyllum* sp.1**

Description. Entire leaf, with acuminate apex, normal acute base and entire margin. Petiole stout. Thin camptodromous venation.

Biometry. Length 90 mm, width 15 mm, height 40.0 mm, l/w 6, h/l 44.44 %, S 7.80 sq. cm- microphyll.

Discussion. This leaf did not allow for a closer assignment. We could not find such a leaf in any reference; consequently we place this specimen in *Dicotylophyllum* sp.1 as it is close in morphology to this genus.

***Dicotylophyllum* sp.2**

Description. A well-preserved obovate leaf with a normally acute base and an obtuse apex. Notched margin, as far as we could see, the teeth have a long concave basal side and a short concave apical one; the sinus is very small and slightly deepened. The leaf seems to be membranaceous and sessile. The venation is pinnate craspedodromous. The primary vein is prominent becoming thinner towards the apex. The secondary veins arise at wide acute angles. They are very thin and numerous alternating more or less parallelly.

Biometry. Length 28 mm, width 15 mm, height of the maximum width 22 mm, l/w 1.86, h/l 78.57 %, S 2.80 sq. cm- microphyll.

Discussion. The references we had on hands did not include a similar type. Therefore, although very well preserved, the leaf has to be included, within the group called *Dicotylophyllum*. However, some features point towards *Rhus*.

***Dicotylophyllum* sp. 3**

Pl. 1, fig. 9

Description. A poor preserved leaf. As far as we could conclude, it seems to be a narrowly oblong narrow (or elliptical narrow?) leaf with a normal acute base and an entire

margin. The texture is membranaceous, the petiole is 7 mm (?) long and the venation is camptodromous pinnate. The primary vein is prominent; the secondaries are thin, alternate and parallel. The leaf has a circular hole at its base, caused by herbivor *Phagophytichnis nigromarginatus* Strauss.

Biometry. Length 19 (?) mm, width 1-7 mm.

Discussion. The assignment of this leaf remains largely unclear. Some features, however, seem to indicate *Salix*.

4 Discussion and Conclusions

This is a typically Sarmatian flora, fully corresponding to the group of Lower Sarmatian floras from Transylvania. It belongs to the category of floras with *Cystoseirites*, without *Palaeocarya,* an element that could not have been identified up to the present stage of our research (GIVULESCU 1992b).

The taphocenosis is not very rich and we should point out the fact that most of the reported taxa are represented by a single sample (the great majority of which are only fragments). Only the nanophyll leaves are entire, the microphyll ones are mainly non-entire. All these facts prove that we are dealing with an accidental taphocenosis in which plants were brought into the basin at different times, originating from different assemblages. A great amount of this material was brought by water. However, some taxa seem to have grown near the area of sedimentation and we mainly refer to the very long needle *Pinus* type, which have been preserved entirely or almost entirely.

Statistically, this flora includes 13 families, with 18 genera and 23 species + 4 doubtful ones. Therefore, we can say that it is a small flora, rich in families and genera. Eight of these species are arctotertiary, 6 are palaeotropical, (57.14 % : 42.85 %). There are 13 trees and 7 shrubs (65 % : 35 %) and also are 8 leaves whose margins are not entire and 7 with entire margins (53.33 % : 46.64 %).

Except for the first ratio (arctotertiary vs. palaeotropical), which seems to overstate the percentage of palaeotropical types, all the other ratios are more or less credible. However, these data remains only informative, as only a restricted vegetation sample is available for study, due to the selective fossilisation. We must mention the fact that the presence of a palm in the Early Sarmatian of Transylvania, *Chamaerops humilis fossilis*, the first certain such one ever found in our country, is an important fact. We cannot be sure if it is necessarily a Miocene relict but it is highly probable that the palm could have found optimal growing conditions at Minişu de Sus as the atmosphere there was probably warmed by volcanic eruptions. The remaining flora is typical for the Early Sarmatian. However, there are Lauraceae (*Daphnogene polymorpha)*, widely spread elements in the Tertiary of Transylvania, as well as *Quercus* cf. *ilex* and *Carya denticulata* that occurred in the Transylvanian floras at this time. *Myrica vindobonensis*, on the other hand, represents a relict, as it is characteristic for the Early Miocene and Oligocene. *Acacia parschlugiana* can be considered to belong to the same category. It is very interesting to note that there are numerous types of *Pinus* and especially that with quaternae needles described at Delureni by GIVULESCU (1961). We should also mention the unique presence in our country of *Zanthoxylon europaeum*, consisting of a compound leaf.

The foliar remnants we studied belong to several palaeoenvironments. Even if we do not take into account the brackish water with *Cystoseirites*, in the surrounding land we could still distinguish two different categories, one of hard ground and one of swampy, more or less flooded areas. This second category includes, *Glyptostrobus, Gleditsia, Myrica, Platanus*, probably *Pinus taedaeformis* and maybe even *Carya.* These types were most probably frequent either in swampy woods or they grew on hard ground, with underground water levels, at different depths. The category of hard ground types included Lauraceae and all remaining Leguminosae taxa, but especially *Chamaerops* and *Quercus* cf. *ilex,* which actually belong to the same assemblages, in western Mediterranean areas. The shrub *Zanthoxylon* and the fern *Pteris* were also present.

As far as the Lower Sarmatian climate is concerned, in this case we were not able to use DILCHER'S method of calculation (1973) since the material was not very rich. However, we have no reason to think that the climate here was in any way different from the one we reported on in our study concerning the Sarmatian from Transylvania (GIVULESCU 1989), namely a warm-temperate and more or less wet climate.

References

ANDRAE, K.J., 1855. Fossile Flora Siebenbürgens und des Banats. I. Tertiärpflanzen von Szakadat und Thalheim in Siebenbürgen. Abh. k. k. geol. R. A., II, 3, 3-30.
ANDREANSZKY, G., 1959. Die Flora der sarmatischen Stufe in Ungarn. Akad. Kiado,1-360.
BARBU, I. Z., 1934. Contribuţii la cunoaşterea florei fosile din Podişul Moldovei. (Contributions to the knowledge of fossil flora from Podişul Moldovei.). Acad. Rom. Mem. S. st. ser. 3, 10, 105-134.
BARBU, I. Z., 1942. Note sur les plants fossiles du Miocene de Slatioara, dep. Vîlcea. Bull. Soc. roum. Geol., V, 120-139.
BARBU, I. Z., 1954. Flora fosilă din Terţiarul Olteniei. (Fossil flora from the Oltenia Tertiary). An. Com. Geol. 27, 5-76.
BARBU, O. & CODREA, V., 1996. Palaeoenvironmental interpretation of the diatomitic facies from Zarand Basin, Western Romania. (Abstract) 14th International Diatom Symposium, 136.
BERGER, W. & ZABUSCH, F., 1953. Die Obermiozäne (Sarmatische) Flora der Türkenschanze in Wien. N. Jb. Geol. Palaont. Abh. 98, 2, 226-276.
BRAUN, AL., 1845. Die Tertiar- Flora von Oehningen. Neu. Jb. Min. Geol. Paläont., 164-173.
BRONGNIART, A., 1833. Notice sur une Conifere fossile du terrain d'eau douce de l'Ile d'Iliodroma. Ann. Sc. nat., I, 30, 168-1175.
BUDANTEV, L. IU. & SVESHNIKOVA, I.N., 1964. Treticinaia flora Kaliningradskogo poluostrova. Paleobot. 5, 83-112.
CODREA, V., 1992. New mammal remains from the Sarmatian deposits at Minişu de Sus (Tauţ, Arad county). Studia Univ. Babeş-Bolyai, Geol. 37 (2), 35-41.
CODREA, V. & BARBU, O., 1996a. Paleomediul volhynian de la Minişu de Sus, jud. Arad. (Volhynian palaeoenvironment from the Minişu de Sus, Arad County). Convergenţe transilvane. 4, 63-65.
CODREA, V. & BARBU, O., 1996b. Some data concerning the faunistic and microfloristic assemblages from the Sarmatian deposits at Minişu de Sus (Arad County). Armonii Naturale I, Muz. Arad, 111-115.
CODREA, V., LASLO-FAUR, A., DUDAŞ, C., 1991a. Gigantic suid: *Listriodon* aff. *lockharti* (POMEL) from the Sarmatian Diatomitic-Tuffaceous Complex at Minişu de Sus (Tauţ, Arad District) - In: The Volcanic Tuffs from the Transylvanian Basin Romania, 93-102.
CODREA, V., LASLO-FAUR, A., DUDAŞ, C., HOSU, A., BARBU, O., 1991b. The first Romanian record of *Deinotherium levius* Jourdan from the Sarmatian diatomitic-tuffaceous complex at Minişu de Sus (Tauţ, Arad district) – In: The volcanic tuffs from the Transylvanian Basin, Romania, 103-109.
CODREA, V., BARBU, O., SĂSĂRAN, E., 1999. Contributions to the Nomenclature of the Badenian Succession from the Crisul Alb Depression. Studia, Ser. Geol., 44/2, 119-124.

ETTINGSHAUSEN, C. v., 1851. Die Tertiärfloren der Österreichischen Monarchie: Fossile Flora von Wien. Abh. K.-K. geol. R. S. 1, 1, 7-36.
ETTINGSHAUSEN, C. v., 1852. Fossile Pflantzenreste aus dem trachyschisten Sandstein von Heiligenkreuz bei Kremnitz. Abh. K.-K. geol. R. S., 1, 1, 1-14.
ETTINGSHAUSEN, C. v., 1853. Beitrag zur Kenntnis der fossilen Flora von Tokay. Sitzber. Denkschr.K. Akad.Wiss. math-naturwiss Kl. 11, 779-816.
ETTINGSHAUSEN, C. v., 1854. Die eozäne Flora des Monte Promina. Denkschr. K. Akad. Wiss. math-naturwiss Kl. 8, 17-44.
ETTINGSHAUSEN, C.v., 1877. Die fossile Flora von Sagor in Krain. Denkschr. K. Akad. Wiss, math-naturwiss Kl. 37, 161-216.
GIVULESCU, R., 1951. Flora fosilă de la Luncşoara, reg. Bihor. (Fossil flora from Luncşoara, Bihor district) Acad. R.P.R., fil. Cluj. Stud. cerc. st, 2, 1-2, 108-126.
GIVULESCU, R., 1954. Note paleobotanice. (Paleobotanical notes). Comunic Acad. R.P.R. 4, 11-12, 639-648.
GIVULESCU, R., 1957. Flora pliocenă de la Cornițel. (Pliocene Flora from Cornițel). Acad. R.P.R. (Monografii geol. paleont.) III, 1-149.
GIVULESCU, R., 1960. Neue Untersuchungen über die pflanzenführenden Mergel von Gheghie (Bez. Oradea- Grosswardein- Rumanien). Acta bot. Acad. sc. Hung. 6, 1- 2, 35-44.
GIVULESCU, R., 1961. Die fossile Flora von Beznea (Bez. Oradea). N. Jb. Geol. Paläont. Abh. 113, 3, 327-350.
GIVULESCU, R., 1962. Die fossile Flora von Valea Neagră, Bez. Crişana, Rumänien. Palaeontogr. B, 110: 128-187.
GIVULESCU, R., 1968a. Cu privire la resturile de Phaeophyta (Fucales) din Terțiarul R.S.România. (Über einige Phaeophyta (Fucales) Reste aus dem Tertiär Rumäniens). Studii cerc. geol. geofiz. geogr., ser. geol.13, 1, 281-284.
GIVULESCU, R., 1968b. Ein neuer Beitrag zur Kenntnis der fossilen Flora von Coruş bei Cluj, Rumänien. Geologie, 17, 5, 572-605.
GIVULESCU, R., 1974. O nouă contibuție la cunoşterea florei fosile de la Chiuzbaia, punctul fosilifer F. (A new contribution to the knowledge of fossil flora from Chiuzbaia, fossiliferous point F.). Contrib. bot., 228-233.
GIVULESCU, R., 1975a. Untersuchung einer Sammlung fossiler Pflanzen von Daia und Săcădat (Kr. Sibiu, Rumänien). Stud. comun. şt. nat. Muz. Brukenthal, 19, 69-79.
GIVULESCU, R., 1975b. Fossile Pflanzen aus dem unteren Pannon von Delureni, Rumäenien. Palaeontogr. B., 153, 4-6, 150-182.
GIVULESCU, R., 1975c. Die Monographie der aus Rumänien beschriebenen Holotypen fossiler Pflanzen. Mem. Inst. Geol.. 22, 1-72.
GIVULESCU, R., 1979. Paläobotanische Studien im Pflanzenfundort Chiuzbaia (Kr. Maramureş-Rumänien). Mem. Inst. Geol.. 28, 63-150.
GIVULESCU, R., 1982. Ein Nachtrag zur Kenntnis der fossilen Flora aus dem Pflanzenfundort Chiuzbaia (Fundort "F"). D. S. Inst. Geol. Geofiz. 66, 3, 131-139.
GIVULESCU, R., 1983. Revision einiger Originale aus M. Staub "Die Aquitanische Flora des Zeilthales in Comitate Hunyad". Acta paleobot. 23, 1, 77-100.
GIVULESCU, R., 1989. Some considerations on the late Miocene flora from Viena-Türkenschanze, Austria. Fedd. Rep. 100, 271-275.

GIVULESCU, R., 1990. Flora fosilă a Miocenului superior de la Chiuzbaia (Fossil flora of the Upper Miocene from Chiuzbaia). Edit. Acad. Rom., 233 p.
GIVULESCU, R., 1993. Revizuirea unor flore din Miocenul Transilvaniei (Revision of several floras from the Transylvanian Miocene). Studia Univ. Babeş-Bolyai, Geol. 38, 2, 19-25.
GIVULESCU, R., 1993-1994. Flora fosilă a Neozoicului din România, II (Fossil flora from the Romanian Neozoic II). Contrib. bot., 103-106.
GIVULESCU, R., 1995-1996. Flora fosilă a Neozoicului din România, III (Fossil flora from the Romanian Neozoic III). Contrib. bot., 77-82.
GIVULESCU, R., 1996a. Quelques observations concernant l'anisophyllie des feuilles du genre *Daphnogene* Unger 1845 (Lauraceae). Studii şi cerc. şt. nat. 2, 43-51.
GIVULESCU, R., 1996b. Flora oligocenă superioară din Bazinul Petroşani. (Upper Oligocene Flora from the Petroşani Basin) Ed. Casa cărţii de şt., 171 p.
GIVULESCU, R., 1997a. La revision du genre *Daphnogene* Unger 1845 de la flore fossile de Roumanie. Rom. J. Paleont. 77, 29-38.
GIVULESCU, R., 1997b. Die fossilen Floren aus der Zeitspanne Oberes Oligozän-Unteres Pliozän, incl. Pleistozän VI, 3. Flora tert Mediterr. 6, 3, 1-79.
GIVULESCU, R., 1997c. Istoria pădurilor fosile din Terţiarul Transilvaniei (History of the Fossil Forests Belonging to the Transylvanian Tertiary Period). Edit. Carpatica, 171 p.
GIVULESCU, R. & BARBU, O., 1999. Eine fossile Palme *Chamaerops hummilis* Linné *fossilis* Kolakovski aus dem Miozän von Rumänien. Beiträge zur Paläontologie, 24, 87-90.
GIVULESCU, R. & GHIURCĂ, V., 1969. Flora pliocenă de la Chiuzbaia (Maramureş). (Pliocene Flora from Chiuzbaia (Maramureş). Mem. Inst. Geol. 10, 1-81.
GIVULESCU, R. & OLOS, E., 1973. Paläobotanische Studien im Tertiär Siebenbürgens. Mem. Inst. Geol. 19, 1-61.
GIVULESCU, R. & RÜFFLE, L., 1986. *Zanthoxylon europaeum* Unger 1848 in der fossilen Flora Rumäniens. Docum. natur. 33, 47-49.
GIVULESCU, R., BARBU, O., CODREA, V., 1995. New Plants from the Volhynian Diatomites at Minişu de Sus. Studia Univ. Babeş-Bolyai, Geol. 40, 2, 63-68.
GIVULESCU, R., PETRESCU, I., BARBU, O., 1993. Vorläufige Mitteilung über die Blattflora von Corneşti-Aghireş (Bez. Cluj, Rumänien) an der Wende Rupel/Chatt. Docum. natur. 80, 11-19.
GIVULESCU, R., PETRESCU, I., BARBU, O., 1996. Observations concernant les feuilles de *Daphnogene* Unger, 1845 (Lauraceae, Magnoliophyta) de l'Oligocene de Corneşti-Aghireş (Department de Cluj, Roumanie), Tertiary Research, 17, 1+2, 1-4.
GOEPPERT, H. R., 1855. Die tertiäre Flora von Schossnitz in Schleisen., 1-52.
GREGOR, H.-J. & HANTKE, R., 1980. Revision der fossilen Leguminosengattung *Podogonium* Heer (= *Gleditschia* Linne) aus dem europäischen Jungtertiär. Fedd. Rep. 91, 3, 151-182.
HANTKE, R., 1965. Die fossilen Eichen und Ahorne aus der Molasse der Schweiz und von Oehningen (Sud-Baden). Neujahrsblatt Naturforsch. Ges. 167, 1-140.
HEER, O., 1855. Flora tertiaria Helvetiae I, 1-118.
HEER, O., 1856. Flora tertiaria Helvetiae II, 1-110
HEER, O., 1859. Flora tertiaria Helvetiae III, 1-200.

HEER, O., 1869. Miozäne Baltische Flora. Beitr. Naturk. Preussens 2, 1-104.
HEER, O., 1883. Die fossile Flora von Grünland. II. Flora fossilis arctica 7, 1-275.
HERENDEEN, P. S., 1992. *Podocarpium podocarpum* comb. nov. the correct name for *Podogonium knorii* Heer, nom. Illeg. (fossil *Fabaceae*). Taxon 41, 4, 731-736.
HUMMEL, A., 1983. The Pliocene leaf flora from Ruszow near Zarg in Lower Silesia, SW Poland. Prace Muz. Ziemi 36, 9-99.
ISTOCESCU, D., 1971. Studiul geologic al sectorului vestic al bazinului Crişului Alb şi al ramei munţilor Codru şi Highiş (Geological Study of the Western Part of the Crişul Alb Basin and of the Codru and Highiş Mountains Frame). St. tehn. ec. Inst. Geol. 8, 1-177.
ISTOCESCU, D. & GIVULESCU, R., 1977. Câteva plante fosile din Sarmaţianul de la Auşeu, Bihor. (Some Plant Remains from the Sarmatian at Auşeu, Bihor). D. S. Inst. Geol. Geofiz. 63, 3, 151-156.
ISTOCESCU, D. & ISTOCESCU, F., 1974. Consideraţii geologice asupra depozitelor neogene ale bazinului Crişurilor (Geological Considerations on the Neogenic Deposits in the Criş Rivers Basin). Stud. cerc. geol. geofiz. geogr., Ser. geol. 19, 115-127.
JUNG, W., 1963. Blatt- und Fruchtreste aus der oberen Süsswasser- Molasse von Massenhausen, Kr. Freising (Oberbayren). Palaeontogr. B 112, 119-166.
KILPPER, K., 1968. Koniferen aus tertiären Deckschichten des neiderrheinischen Hauptflozes. 4- Taxodiaceae und Cupressaceae. Palaeontogr. B 124, 4-6, 102-111.
KNOBLOCH, E., 1961. Die oberoligozäne Flora des Pirskenberges bei Sluknov in Nord Böhmen. Sb. ustr. ust. geol. 26, 241-313.
KNOBLOCH, E., 1969. Tertiäre Floren von Mahren. Moravske Mus. Brno, 1-192.
KNOBLOCH, E., 1971. Berichtigungen zur miozänen Flora der Rhon mit Bemerkungen zur Alterstellung. Mitt. Bayer St.-Samml. Palaont. hist. Geol., 11, 251-262.
KNOBLOCH, E. & KVACEK, Z., 1976. Miozäne Blätterfloren von Westrand der Böhmischen Masse, in Rozpr. Ustr. ust. geol. 47, 1-220.
KOLAKOVSKI, A. A., 1964. Pliotsenovaya flora Kodora. Akad. Nauk Gruz. SSR Suhumski Bot. Sad. Monografii 1, 1-208.
KRÄUSEL, R., 1938. Die tertiäre Flora der Hydrobienkallke von Mainz-Kastel. Palaeont. Z. 20, 9-103.
KRESTEL, S., 1970. Studiul micropaleontologic al diatomitelor din Republica Socialistă România (Micropalaeontological Study of Diatoms in the Socialist Republic of Romania). Tez. doct.Univ. Bucuresti, 1-207.
KRISHTOFOVICI, A. N. & BAIKOVSKAIA, T. N., 1965. Sarmatskaia flora Krinki. Akad. Nauk SSSR, Bot. Inst.Komarov, 1-134.
MAI, D. H. & WALTHER, H., 1978. Die Floren der Haselbachner Serie im Weiselster-Becken (Bez. Leipzig, DDR). Abh. Staatl. Mus. Mineral. Geol. 28, 1-200.
MARTY, P., 1903. Flore miocene de Joursac. Rev. Haute Auverge 5.
MAXIM, I. & PETRESCU, I., 1966. Flora Pliocenă din Bazinul Baraolt. (Pliocene Flora from the Baraolt Basin). Studia Univ."Babeş-Bolyai", Geol.- Geograph., 2, 121-123.
MORGENTHAL, L., 1964. Die Nadelgehölze. OstavFischer Verl., 1-337.
NEMEJC, F. & KNOBLOCH, E., 1973. Die Makroflora der Salgotarjaner Schichtengruppe (Die Flora aus Lipovany) Chronostr. Neostrat. Miozan M_2-Ottnang., Bd. III, 694-759.

NICORICI, E., 1976. *Trilophodon angustidens* (Cuvier) din Sarmaţianul inferior de la Minişul de Sus (bazinul Zarandului). (*Trilophodon angustidens* (Cuvier) from the Lower Sarmatian at Minişul de Sus, Zarand Basin). D. S. Inst. Geol. Geofiz. 62, 3, 77-79.
PETRESCU, I. & GIVULESCU, R., 1986. Flore et vegetation de la "Vallee du Jiu" (Bassin de Petrosani) Roumanie. Rev. de Paleobiologie 5, 1, 109-116.
PETRESCU, I., GIVULESCU, R., BARBU, O., 1995. The Oligocene Macro-and Microflora from Corneşti-Aghireş (NW of Romania)- General View, I. Ferns and Conifers. Rev. de Paleobiologie, 14, 1, 209-219.
PETRESCU, I., GIVULESCU, R., BARBU, O., 1997. Macro- şi microflora oligocenă de la Corneşti-Aghireş, România (The Oligocene macro-and microflora from Corneşti-Aghireş, Romania). Edit. Carpatica, 1-215.
PIMENOVA, I. B., 1954. Sarmatskaia flora Avrosievki. Edit. Akad. Nauk Ukr. SSR. Tr. Inst. geol. nauk 8, 3-95.
POP, E., 1936. Flora pliocenică de la Borsec (The Pliocene Flora from Borsec). Edit. Univ. Regele Ferdinand, 1-136.
SAGATOVICI, AL. & ANASTASIU, N., 1972. Studiul piroclastitelor de la Minişu de Sus (Study of the Piroclasts from Minişu de Sus). An. Univ. Buc., Ser. Şt. Nat., Geol., 31-41.
SAPORTA, G. de 1865. Etude sur la vegetation du SE de la France a l'epoque tertiaire. Ann. sc. nat. 4, 5-264.
SAPORTA, G. de & MARION, L., 1876. Recherches sur le vegetaux fossils de Meximieux. Arch. Mus. hist. nat. Lyon I, 131-335.
SĂSĂRAN, E., CODREA, V., BARBU, O., 1999: Facies Assemblages and Architecture of the Sedimentary Environments from the Carand Formation (Sarmatian) in Zarand Depression (Western Romania). Studia, Ser. Geol., 44, 2, 103-117.
SCHIMPER, W., 1872. Traite de paleontologie vegetale III, 1-966.
STANCU, I. & ŢICLEANU, N., 1975. Date noi privind flora Badenianului din România. (New Data about Badenian Flora from Romania). D. S. Inst. Geol. Geofiz. 61, 3, 185-203.
STAUB, M., 1887. Stand der phytopaleaeontologischen Sammlung der kgl.ung. geol. A.am Ende des Jahres 1885. Jahr. d. kgl. geol. A. f.1885, 179-208.
STAUB, M., 1891. Neue Daten zur fossilen Flora von Felek bei Klausenburg. Foldt. Kozl., 21, 380-382.
STEFANOFF, B. & JORDANOFF, D., 1935. Studies upon the Pliocene Flora of the Plain of Soffia. Sb. Acad. Sc. Bulg. 29, 3-150.
STERNBERG, K.v., 1820-1833. Versuch einer geognostisch- botanischen Darstellung der Flora der Vorwelt, 8 Fasc.
ŞTEFÂRŢĂ, A.G., 1997. Flora miocenă din interfluviul Nistru-Prut. (The Miocene Flora from Nistru-Prut Watershed). Acad. Şt. Rep. Moldova (autoreferat), 1-54.
ŞURARU, N., ŞURARU, M., GIVULESCU, R., 1978. Sarmaţianul de la Valea Băiţa (Borod) şi paleoflora lui. (The Sarmatian from Băiţa Valley (Borod) and its Paleoflora). Nymphaea, 6, 65-92.
ŢICLEANU, N. & ARTIN, L., 1982. Date noi privind flora Sarmaţianului de la Deva – Tâmpa. (New Data about Sarmatian Flora from Deva - Tâmpa). D. S. Inst. Geol. Geofiz. 66, 3, 173-186.

ŢICLEANU, N. & GIVULESCU, R., 1978. Contributions to the knowledge of the Upper Egerian palaeoflora. Fossil Flora of Corus II, Cluj Depart. Cour. Forsch. Inst. Senckenberg 31, 133-150.
ŢICLEANU, N. & GIVULESCU, R., 1982. Plantes fossiles dans les depots du Saramatien de Racşa, distr. De Satu Mare. D. S. Inst. Geol. Geofiz., 66, 3, 115-126.
UNGER, Fr., 1847. Chloris protogaea. Heft 8-10, 93-149.
UNGER, Fr., 1850. Die fossile Flora von Sotzka. Denkschr. K. Akad. Wiss. math. Naturw., Kl.2, 131-197.
UNGER, Fr., 1852. Iconographia plantarum fossilium. Denkschr. K. Akad. Wiss. math. Naturw., Kl. 4, 73-118.
VELITZELOS, E. & SCHNEIDER, H. E., 1978. Jungtertiäre Pflanzenfunde aus dem Becken von Vegora in West-Mazedonien. 3. Mitteilung: Eine Fächerpalme (*Chamaerops humilis* L.). Ann. Geol. Hellen., 29, 796-799.
VREMIR, M., CODREA, V., FARKAS, B., 1997. *Trionyx stririacus* Peters 1855 (Reptilia, Testudines) from the Sarmatian at Minişu de Sus (Tauţi commune, Arad District, Romania). Annls. Hist. Nat. Mus. Hung., 89, 43-52.
WALTHER, H., 1964. Paläobotanische Untersuchungen im Tertiär von Seifhennersdorf. Jb. Staatl. Mus. Mineral. Geol., 1-132.
WEBER, O., 1852. Die Tertiärflora der niederrheimischen Braunkohlenformation. Paleontogr. 2, 117-236.

PLATES

Plate 1

1. *Cystoseirites partschi* Sternberg - desintegrated thallus
2. *Cystoseirites partschi* Sternberg
3. *Myrica vindobonensis* (Ettinghausen) Heer
4. *Fucus* sp.2
5. *Glyptostrobus europaeus* (Brongniart) Unger - female cones
6. *Gleditsia lyelliana* (Heer) Hantke
7. *Cassiophyllum berenices* (Unger) Kräusel
8. *Pteris radobojana* Unger
9. *Dicotylophyllum* sp.3

Plate I

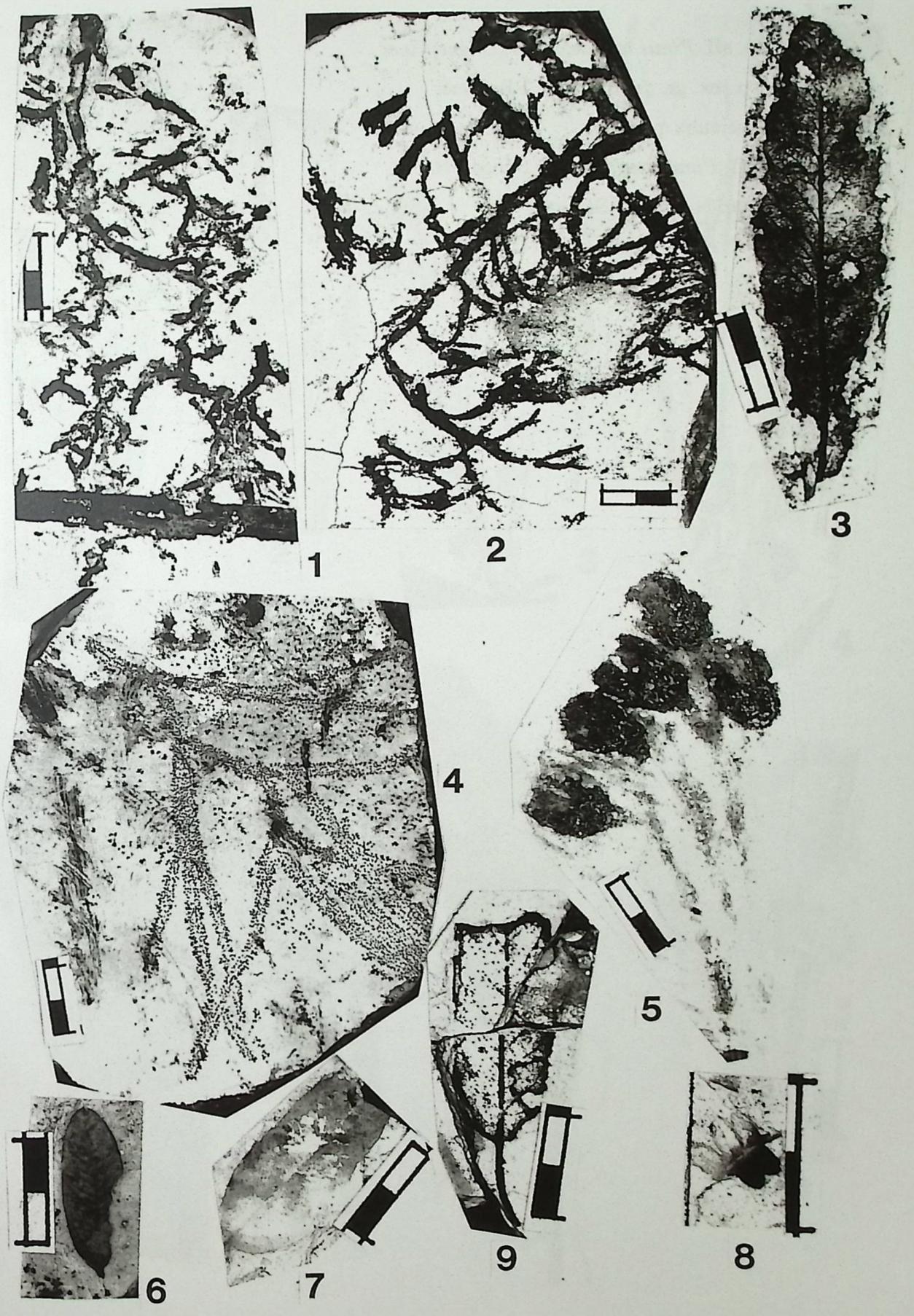


Plate 2

1, 2. *Pinus* sp. aff. *Pinus taedaeformis* (Unger) Heer

3, 4. *Pinus* sp., ex. gr. *quinae*- type 1 Beissner

5. *Pinus* sp.- aciculis quaternis

6. *Pinus* sp. aff. *Pinus taedaeformis* (Unger) Heer

7. *Myrica lignitum* (Unger) Saporta

8. *Pinus* sp. aff. *Pinus taedaeformis* Unger

Plate II

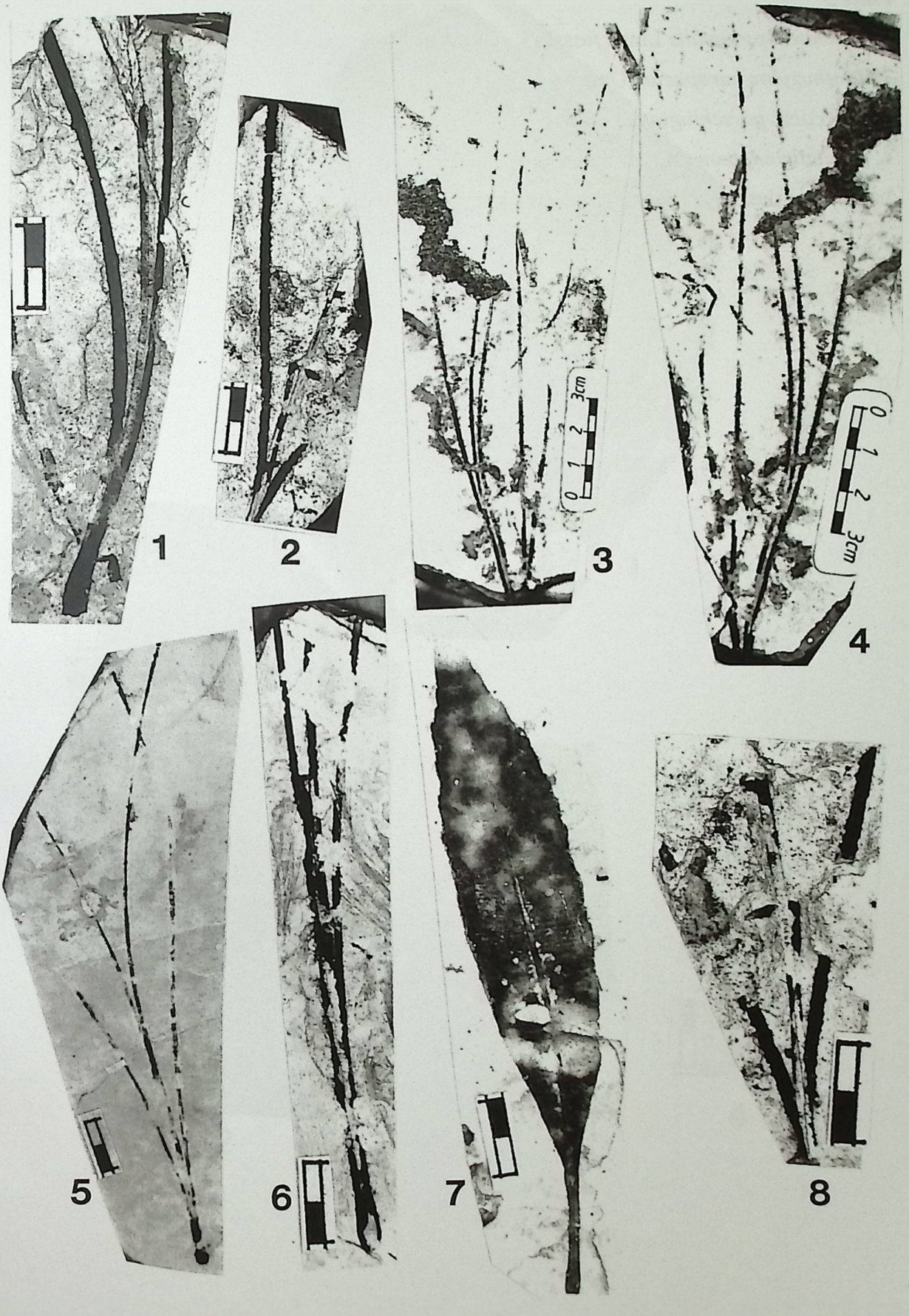


Plate 3

1. *Chamaerops humilis* Linne *fossilis* Kolakovski

2. *Zanthoxylon europaeum* Unger

3. cf. *Acacia parschlugiana* Unger

4. *Myrica vindobonensis* (Ettinghausen) Heer

In all cases the bar at the margin of figure represents 1 cm.

Plate III

1

2

3

4