

NEW CONTRIBUTIONS TO THE CIOCADIA MIDDLE MIOCENE FLORA (PART ONE)

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Abstract. The present paper re-evaluates the record of Middle Miocene (Late Badenian-Early Sarmatian) plant megafossils in the Ciocadia area (North of Oltenia Province) according to current taxonomy, and describe new fossil plant remains. Some previous taxa determinations have been found incorrect or updated. At the same time, we provide new diagnosis for some misinterpreted taxa (*Sphaerites*, *Platanus*) and in the case of just signalled or figured taxa (*Cystoseirites*, *Tetraclinis*, *Cunninghamia*, *Glyptostrobus*, *Picea*).

Keywords: plant fossils, Ciocadia, leaf assemblage, Middle Miocene.

Rezumat. Noi contribuții la flora miocen medie de la Ciocadia (partea întâi). În acest articol sunt reevaluate resturile macroscopice de plante fosile de vârstă badenian superioară-sarmatian inferioară (Miocen mediu) din zona Ciocadia (nordul Olteniei) în acord cu taxonomia actuală și sunt descriși noi taxoni vegetali. Câteva determinări taxonomice anterioare au fost dovedite drept incorecte sau au fost actualizate. În același timp, au fost realizate noi determinări pentru taxoni interpretați greșit (*Sphaerites*, *Platanus*) sau pentru taxoni doar semnați sau figurați (*Cystoseirites*, *Tetraclinis*, *Cunninghamia*, *Glyptostrobus*, *Picea*).

Cuvinte cheie: plante fosile, Ciocadia, asociație de frunze fosile, Miocen mediu.

INTRODUCTION

New and so far undescribed vegetal remains of the Ciocadia river fossil flora have been studied. The Ciocadia fossil flora is the richest and the most important Upper Badenian-Lower Sarmatian flora from Romania (ȚICLEANU, 1984; PARASCHIV, 2005, 2008a, b) with more than 40 taxa consisting of leaves, fruits, seeds and flowers (Table 1). This study is planned to complete the knowledge of Cenozoic floras from Romania. In several parts, we start to revise and add new taxa (PARASCHIV, 2008b) for some floras of Oltenia Province (Forecarpathian Basin). POPESCU (1953), TUDOR (1955), MARINESCU (1969) and HUICĂ (1994) studied in detail the Ciocadia Valley's geology and stratigraphy. The fossil plants are preserved in dark grey marls of the so-called "Spirialis Marls" unit, which represent the Late Badenian (Kossovian) and laminated marls of the Early Sarmatian (Volhynian).

MATERIAL AND METHODS

New leaves, fruits, seeds, and flower impressions were identified only on the basis of macro-morphological features because cuticles are not preserved. The fossil material is preserved mostly as impressions, rare as compressions with the organic matter calcified. For detailed observations and studies of the fossil remains a binocular magnifying glass was used. The specimens are housed in the collections of the Paleobotanical Branch of the National Museum of Geology of the Geological Institute of Romania, Bucharest. All specimens are labelled with the locality abbreviation between BCI.0127 and BCI.0368. The accepted morphological terminology used is mainly based on HICKEY (1979). Systematic organization and taxonomic terminology in this article are based on the works of KIRK et al. (2008), BRODIE & LEWIS (2007), KUBITZKI (1990) and TAKHTAJAN (2009).

Systematic Paleobotany

We outline in this chapter new species or undescribed/unfigured species in the Ciocadia record.

Phylum Eumycota (Fungi) CAVALIER-SMITH 1993

Class Ascomycota CAVALIER-SMITH 1998

Order Xylariales NANNFELDT 1932

Family Sphaeriaceae FRIES 1825 (=Xylariaceae TULASNE & C. TULASNE 1861)

Genus *Sphaerites* UNGER 1850

Sphaerites sp.

Pl. I, Fig. 1.

Material: BCI.0327, BCI.0535.

Description. Perithecia impressions of some saprophyte and parasite stromatic ascomycetous fungi, fixed on angiosperm leaves. Spherical fruitbody or carbonified mycelia up to 3 mm in diameter are preserved. The perithecia are ring structured and is represented by dark spherical corps with rounded inner depressions and a central ridge or hole in the middle is presented. Almost all the perithecia are disposed on the superior part or grouped in clusters in the central part of the leaves.

Remarks. Such fossils are reported also from Slătioara (Badenian-Sarmatian), Morilor Valley (Sarmatian), Tirol (Pannonian), Chiuzbaia (Pontian), Borsec (Dacian).

Phylum Ochrophyta CAVALIER-SMITH 1995

Class Phaeophytae KJELLMAN 1891

Order Fucales KYLIN 1917

Family Cystoseiraceae KUETZING 1843

Genus *Cystoseirites* STERNBERG 1833

Cystoseirites partschii STERNBERG 1833

Pl. I, Figs. 2, 3.

Material: BCI.0140, BCI.0570.

Description. Impressions of parenchymatous thalli fragments, dichotomously ramified, without holdfast. The thalli consist on a principal axis where are inserted numerous blades, branches and floats (or pneumatocysts). The length of the floats is 17 to 15 mm, and the diameter is of 5-6 mm. The pneumatocysts are strangulated several times (2-4) and distally ended with dichotomic filaments.

Remarks. Fragments of *Cystoseirites* thalli are frequently found in the Middle Miocene deposits of Romania, at Slătioara (Badenian-Sarmatian), Morilor Valley (Sarmatian), Tâmpa (Sarmatian), Daia-Săcădate (Sarmatian), Feleac (Sarmatian), Racșa (Sarmatian), Cavnic (Sarmatian).

Phylum Pinophyta CRONQUIST 1996

Class Pinopsida BURNETT 1835

Order Cupressales BROMHEAD 1838

Family Cupressaceae RICHARD ex BARTLET 1830

Genus *Tetraclinis* MASTERS 1892

Tetraclinis salicornioides (UNGER 1841) Z. KVAČEK 1989

Pl. I, Figs. 4, 5, 6, 7.

Material: BCI.0270, BCI.0298, BCI.0619, BCI.0626.

Description. Twig fragments with attached/detached articles (leaves) or seed compressions. Foliage twigs are mostly opposite branching, dichotomously ramified (until the fourth order). The scale-like leaves are polygonal shaped or elongated, flattened distally, with the base concave. Longitudinal nervation is obvious and divergent ribs go opposite to the main vein toward the upper part of the leaf. Seeds have two wings, equally, membranous, ovate to subglobulose in shape, or reniform, symmetrically disposed on the body. The central body of the seed is subcylindrical to triangular, with rounded base and bilobed micropylar tip.

Remarks. *Tetraclinis* is often found in the Cenozoic deposits of Romania at Bizușa (Early Oligocene), Cornești-Aghireș (Oligocene), Almașului Valley (Oligocene), Coruș (Acvitanian), Pâncota (Badenian), Slătioara (Badenian-Sarmatian), Tâmpa-Deva (Sarmatian), Lunșoara (Sarmatian), Morilor Valley (Sarmatian), Borod-Borozele (Pannonian), Cornișel (Pannonian), Crișului Valley I-II (Pannonian), Vadu-Crișului (Pannonian), Chiuzbaia (Pontian).

Family Taxodiaceae WARMING 1884

Genus *Cunninghamia* R. BROWN ex RICHARD & A. RICHARD in A. RICHARD 1826

Cunninghamia sp.

Pl. I, Figs. 8, 9.

Material: BCI.0201, BCI.0580.

Description. Impressions of branches with needle-like leaves of 15 mm length and 2 mm wide, short-petiolate, disposed spirally around the stem and curved upward; after fossilization the leaves have alternate arrangement. The apex of the leaves is softly spined.

Remarks. *Cunninghamia* remains are rarely found in the Cenozoic deposits of Romania at Tâmpa (Badenian), Morilor Valley (Sarmatian), Aușeu (Sarmatian), Valea-de-Criș (Pannonian), Neagră Valley (Pannonian), Băile Homorod (Pannonian), Chiuzbaia (Pontian).

Genus *Glyptostrobus* ENDLICHER 1847

Glyptostrobus europaeus (BRONGNIART 1833) UNGER 1850

Pl. I, Fig. 10.

Material: BCI.0245, BCI.0248.

Description. Fertile deciduous shoot fragments (but without preserved cones) up to 30 mm in length with scale-like leaves, helically arranged on the stem. The leaves are ad-pressed, squamous, imbricated, with ad-axial surface convex, base decurrent and acuminate and incurved apex.

Remarks. Without preserved cuticle such twigs are morphologically indistinguishable from another taxodiacean, the extinct *Quasisequoia couttsiae* (KUNZMANN 1999), but we plead for the previously taxon because of its high frequency in the Cenozoic deposits of Romania: the Jiu Valley (Late Oligocene-Egerian), Slătioara (Badenian-Sarmatian), Morilor Valley (Sarmatian), Fizeș (Sarmatian), Racșa (Sarmatian), Luncșoara (Sarmatian), Daia and Săcădate (Sarmatian), Borod-Borozeș (Pannonian), Cornișel (Pannonian), the Crișului Valley II (Pannonian), Delureni (Pannonian), Tirol (Pannonian), Oaș (Pannonian-Pontian), Băița (Pontian), Sărmășag-Chieșd (Pontian), Derna (Pontian), Sinersig (Pontian), Biborțeni (Pontian), Chiuzbaia (Pontian), Derna (Pontian), Borsec (Dacian).

Order Pinales DUMORTIER 1829

Family Pinaceae LINDLEY 1836

Genus *Pinus* LINNAEUS 1753

Pinus sp.

Pl. I, Fig. 11; Pl. II, Figs. 1, 2.

Material: BCI.0336, BCI.0338, BCI.0527.

Description. Compressions of small male cones of ?2.4 mm length and 3 (5) mm wide. The cones are composed of spirally arranged microsporophylls. There is obviously the central axis of the cone (microstrobilus) and the microsporophylls (modified leaves) and even some microsporangia, which bear the pollen sacs.

Remarks. Such cones are present only for a short period of time in the axil of a scale leaf (during spring or, rarely in autumn), clustered around the bases of young shoots and falling as soon as they shed their pollen. The fossil distribution in Romania: Cornești-Aghireș (Oligocene), Slătioara (Badenian-Sarmatian), Morilor Valley (Sarmatian), Valea Neagră (Pannonian), Cornișel (Pannonian), Borsec (Dacian).

Pinaceae sp.

Pl. II, Figs. 3, 4.

Material: BCI.0244, BCI.0553.

Description. The compression of a incomplete young branchlet of ?28 cm length and 13 (to 5) mm wide, strongly incurved, asperous in texture. The shoot presents four obvious growth increments, which are generated by the annual rhythms. The surface of the bark is ornamented with large rhomboidal scales in the portions between the growth rings and imbricate fish-like scales in the growth areas. All the scales are disposed helically on the branchlet, representing the insertion scars of the leaves. It is worth mentioning that the growth sections of the branchlet are separated by two distal strangulations, which correspond to flexure points.

Remarks. There are not too many such fossils described because of the scarce diagnostic elements. In our case, only the *Pinaceae* family presents such characters. In Romania similar branchlets were found at Borsec (Dacian), assign to *Pinus leucodermis* ANTOINE vel *nigra* s.l.? by POP E. (1936).

Genus *Picea* A. DIETRICH 1824

Picea sp.

Pl. II, Figs. 5, 6.

Material: BCI.0339, BCI.0609.

Description. Small winged seed compressions of 11 (12) mm length and 4 mm wide. The seed is held in a shallow cup, covered fully on the one side but not at all on the other. Seed is sub-triangular, 3-4 mm, spiny. Wing elliptic, asymmetrical, base not or very slightly thickened and distally rounded.

Remarks. *Picea* seeds are cited in Romania from: Slătioara (Badenian-Sarmatian), Morilor Valley (Sarmatian), Cornișel (Pannonian), Chiuzbaia (Pontian).

Phylum Magnoliophyta CRONQUIST 1996

Class Magnoliopsida (*Dicotyledons*) BRONGNIART 1843

Order Laurales PERLEB 1826

Family Lauraceae JUSSIEU 1789

Genus *Laurophyllum* GOEPPERT 1857

Laurophyllum sp.

Pl. II, Figs. 7, 8.

Material: BCI.0306, BCI.0135.

Description. Impression of specimens of lanceolate to elliptic, obovate leaves of entire margin (7-8 cm long and 1.5 - 3 cm wide), with strong petiole, midrib slightly curved, strong evidenced, base cuneate, apex acute to acuminate, thick coriaceous texture. The venation is eucamptodromous, secondary veins regularly widely spaced, arch-like, looping near the margin, no clear detail of higher order venation observable.

Remarks. These are typical lauroid leaves, but without preserved cuticle, it is impossible to relate a precise species. *Laurophyllum* is very commonly found in Cenozoic deposits of Romania at: Coaş (Early Oligocene), Bizuşa (Early Oligocene), Corneşti-Aghireş (Oligocene), the Jiu Valley (Late Oligocene-Egerian), Coruş (Acvitanian), Pâncota (Badenian), Căstău (Badenian), Slătioara (Badenian-Sarmatian), Borod (Sarmatian), Racşa (Sarmatian), Feleac (Sarmatian), Morilor Valley (Sarmatian), Băile Săcel (Sarmatian), Tâmpa-Deva (Sarmatian), Luncoşoara (Sarmatian), Daia and Săcădate (Sarmatian), Corniţel (Pannonian), Crişului Valley I-II (Pannonian), Delureni (Pannonian), Vadu-Crişului (Pannonian), Băiţa (Pontian), Chiuzbaia (Pontian).

Table 1. Summary of revised floristic composition of the Ciocadia fossil flora.
Tabel 1. Compoziţia floristică revizuită a florei fosile de la Ciocadia.

Taxa	ȚICLEANU (1984)	PARASCHIV (2005)	PARASCHIV & SEBE (2007)	PARASCHIV (2008 a)	PARASCHIV (2008 b)
<i>Sphaerites</i> sp.				x (Δ) (Φ)	
<i>Cystoseirites partschii</i> STERNBERG				y (Δ) (Φ)	
<i>Eostangeria</i> cf. <i>ruzinciniana</i> (PALAMAREV, PETKOVA et UZUNOVA) PALAMAREV & UZUNOVA					♣
<i>Tetraclinis salicornioides</i> (UNGER) Z. KVAČEK	— ♣	— ♣ (Δ)		● — ♣ (Δ) (Φ)	
<i>Cunninghamia</i> sp.				— ♣ (Δ)	
<i>Glyptostrobus europaeus</i> (BRONGNIART) UNGER		— ♣ (Δ)		— ♣ (Δ) (Φ)	
<i>Pinus</i> sp.	♣ ●	● (Δ) □ (Δ)		● ♣ □ (Δ)	
<i>Picea</i> sp.				● (Δ) (Φ)	
<i>Pinaceae</i> sp.				— (Δ) (Φ)	
<i>Laurophyllum</i> sp. 1	♣	♣ (Δ)		♣ (Δ)	
<i>Laurophyllum</i> sp. 2		♣ (Δ)		♣ (Δ) (Φ)	
<i>Daphnogene polymorpha</i> (AL. BRAUN) ETtingshausen	♣	♣ (Δ)		♣ (Δ)	
<i>Platanus</i> sp.		● (Δ)			
<i>Berberis</i> sp.		♣ (Δ)			
<i>Fagus silesiaca</i> WALTHER & ZASTAWNIK				♣ (Δ)	
<i>Quercus kubinyii</i> KOVÁTS ex ETtingshausen	♣	♣ (Δ)		♣ (Δ) (Φ)	
<i>Quercus gigas</i> GOEPPERT emend. WALTHER & ZASTAWNIK		♣ (Δ)		♣ (Δ) (Φ)	
<i>Betula</i> cf. <i>macrophylla</i> (GOEPPERT) HEER	♣				
<i>Betula longisquamosa</i> MÄDLER		● (Δ)		● (Δ) (Φ)	
<i>Alnus</i> sp.		□ (Δ)		□ (Δ) (Φ)	
<i>Carpinus</i> sp. div.	■	■ (Δ)		■ (Δ) (Φ)	
<i>Myrica</i> sp.				♣ (Δ)	
<i>Juglans</i> sp.		■ (Δ)		■ (Δ) (Φ)	
<i>Carya denticulata</i> (WEBER) W. SCHIMPER	♣				
<i>Engelhardia orsbergensis</i> (WESSEL & WEBER) JÄHNICHEN, MAI & WALTHER	♣	♣ (Δ)		♣ (Δ) (Φ)	
<i>Engelhardia macroptera</i> (BRONGNIART) UNGER				■ (Δ) (Φ)	
<i>Byttneriophyllum</i> sp.		■ (Δ)		■ (Δ) (Φ)	
<i>Ulmus</i> sp.	■	■ (Δ)		■ (Δ)	
<i>Cedrelospermum</i> sp.		■ (Δ)	■		■
<i>Leguminosites parschlugianus</i> (UNGER) KOVAR-EDER & Z. KVAČEK	■ ♣			■ ♣ (Δ) (Φ)	
<i>Podocarpium podocarpum</i> (AL. BRAUN) HERENDEEN		♣ (Δ)			
<i>Acer</i> sp. div.	■	■ (Δ)		■ (Δ) (Φ)	
<i>Ziziphus</i> sp.		♣ (Δ)		♣ (Δ) (Φ)	
<i>Hedera auriculata</i> HEER				♣ (Δ)	
<i>Fraxinus macroptera</i> ETtingshausen		■ (Δ)		■ (Δ) (Φ)	
<i>Dicotylophyllum</i> sp. 1	♣	♣ (Δ)		♣ (Δ)	
<i>Dicotylophyllum</i> sp. 2	♣	♣ (Δ)			
<i>Dicotylophyllum</i> sp. 3	♣				
<i>Dicotylophyllum</i> sp. 4	♣				
<i>Dicotylophyllum</i> sp. 5	♣				

Explanations: ♣ - leaves, leaflets; ● - seeds; ■ - fruits, involucre, bracts, samaras, pods; — - twigs, branches; □ - inflorescences, flowers; x - fungal mycelium; y - algal thalli; (Δ) - undescribed; (Φ) - unfigured.

Explicații: ♣ - frunze, foliole; ● - semințe; ■ - fructe, involucre fructifere, bractee, samare, păstăi; — - crengi, ramuri; □ - inflorescențe, flori; x - micelii fungale; y - tal de alge; (Δ) - fără descriere; (Φ) - fără figurație.

Order Hamamelidales GRISEBACH 1854

Family Platanaceae T. LESTIBOUDOIS ex DUMORTIER 1829

Genus *Platanus* LINNAEUS 1753

Platanus sp.

Pl. II, Figs. 9, 10.

Material: BCI.0303, BCI.0315.

Description. Single-seeded achenes (7 mm length and 1 mm wide) with a hairy tuft at the base, which aid wind dispersal. The hairy tuft from the base of each achene is made by thin stiff bristle fibres attached in a ring form. The seed body is linear-obovate, widened distally and ended with a hairy stigma. There are no remains of fruit heads preserved, but only numerous detached achenes.

Remarks. Achenes of *Platanus* are founded also in the Morilor Valley (Sarmatian) flora.

RESULTS AND DISCUSSIONS

In the previous work of PARASCHIV (2008a) at the page 38, it was reported the presence of *Fungi* div. sp. in the fossil flora of Ciocadia, but devoid of diagnosis and figuration. Now we clearly describe and figure the taxon under its right name, *Sphaerites* sp. *Cystoseirites partschii* is only signalled (PARASCHIV, 2008a) in Ciocadia, and now we bring the taxon into the light. Rare findings like seeds of *Tetraclinis salicornioides* are for the first time described in Romania. The taxon *Cunninghamia* vel *Cephalotaxus* sp. (PARASCHIV, 2008a) should be replaced with *Cunninghamia* sp. after refined determinations. Male cones of *Pinus* are firstly reported from the Miocene deposits of the Forecarpathian Basin. Another taxon revised from PARASCHIV (2008a) is *Cupressaceae* sp. indet. p. 38, fossil shoots, which belong more exactly to *Pinaceae* family due to the presence of annual growth rings. Due to leaf homeomorphism, the determination of *Laurophyllum* has little systematic value, but without preserved cuticle, we are unable to advance further. The unknown affinity of *Seminae* indet. (PARASCHIV, 2005a, p. 132, Pl. IV, fig. 1) was elucidated after studying the achenes of *Platanus* in herbaria and in the fossil flora of the Morilor Valley. In Table 1, we placed all the taxa known until now from the Ciocadia fossil flora. Most of them are valid but require much more attention because of the poor description and figuration.

CONCLUSIONS

This is the first part of a series of contributions, which will clarify the floristic and vegetation aspects of the Miocene fossil floras of Oltenia Province. The floristic composition of Ciocadia site is similar to other coeval floras of the Forecarpathian Basin (the Morilor Valley, Pârlagele, Slătioara, Pătărlagele) or Transylvanian Basin (Căstău-Orăștie, Hășdate) but its importance is increased due to its richer taxa.

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Fig. 1



Fig. 2



Fig. 3

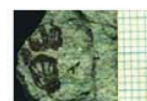


Fig. 4

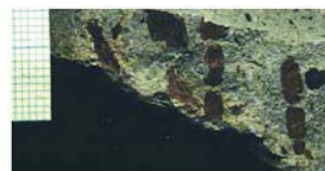


Fig. 5

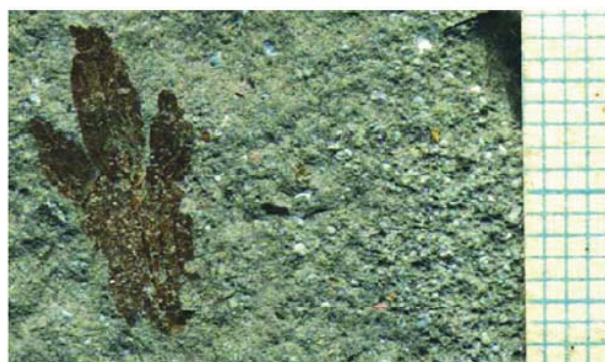


Fig. 6

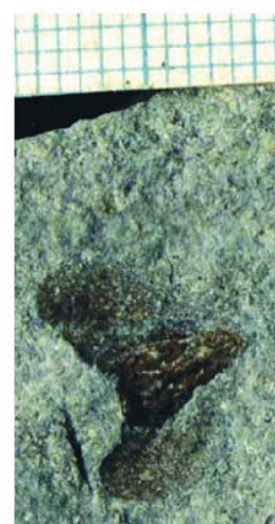


Fig. 7



Fig. 8

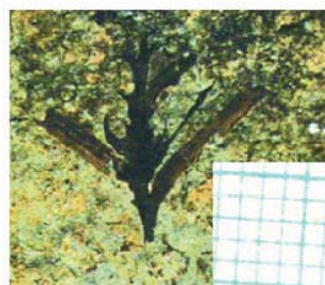


Fig. 9

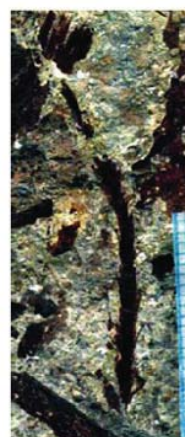


Fig. 10



Fig. 11

PLATE IFig. 1 - *Sphaerites* sp.Fig. 2, 3 - *Cystoseirites partschii* STERNBERGFig. 4, 5, 6, 7 - *Tetraclinis salicornioides* (UNGER) Z. KVAČEKFig. 8, 9 - *Cunninghamia* sp.Fig. 10 - *Glyptostrobus europaeus* (BRONGNIART) UNGERFig. 11 - *Pinus* sp.



Fig. 1

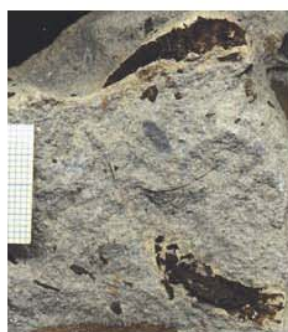


Fig. 3



Fig. 2



Fig. 5



Fig. 6



Fig. 8



Fig. 7



Fig. 9

Fig. 10

**PLATE II**Fig. 1, 2 - *Pinus* sp.Fig. 3, 4 - *Pinaceae* sp.Fig. 5, 6 - *Picea* sp.Fig. 7, 8 - *Laurophyllum* sp.Fig. 9, 10 - *Platanus* sp.