CONTRIBUTIONS CONCERNING THE DACIAN FLORA IN SOUTHWEST OF OLTENIA

DIACONU FLORINA, ŢICLEANU NICOLAE

Abstract. *Although in the Danube - Motru area the majority of the Pliocene deposits are sandy due to the large development of the Berbesti Formation, even if in these circumstances fossil plants had been found too. The plants samples were collected from the roof of the IV-th coal seam represented by grey, massive clay with various thicknesses, from few centimetres up to 6 m. The fossil plants assemblages allowed to point out about 16 taxa, collected either from the sterile strata (foliar imprints and bracts, or from the coal seam witch yielded branches and stems.*

Keywords: *Dacian, macroflora, Husnicioara open pit, Oltenia.*

Rezumat. ***Contribuţii privind flora dacianã din sud-vestul Olteniei.*** *În sectorul Dunăre – Motru depozitele pliocene sunt predominant nisipoase, datorită largii dezvoltări a Formaţiunii de Berbeşti, dar cuprind şi puţine argile cu plante fosile. Materialul paleofloristic a fost colectat din acoperişul stratului IV de cărbune reprezentat printr-o argilă cenuşie, compactă cu grosimi variabile, de la câţiva centimetri până la 6 m. Resturile vegetale care au permis identificarea a 16 taxoni provin din intervalele sterile (amprente foliare şi involucres fructifere) dar şi din stratele de cărbuni în care s-au găsit ramuri şi trunchiuri.*

Cuvinte cheie: *Dacian, macroflora, cariera Husnicioara, Oltenia.*

INTRODUCTION

Although in the Danube - Motru area of the Dacian Basin the majority of the Pliocene deposits are sandy, because of the large development of the Berbesti Formation (Getian), even if in these circumstances some fossil plants had been found too. Such an example is in Dedovita, were TICLEANU et al. (1982) mentioned an Upper Dacian flora including: *Pinus* sp., *Sequoia abietina* (BRONGNIART) KNOBLOCH, *Glyptostrobus europaeus* (BRONGNIART) UNGER, *Alnus* sp., *Betula* cf. *macrophylla* (GOEPPERT) HEER, *Carya serrifolia* (GOEPPERT) KRAUSEL, *Juglans acuminata* AL. BRAUN, *Salix integra* GOEPPERT, *Salix* sp. aff. *S. varians* AL. BRAUN, *Liquidambar europaea* AL. BRAUN, *Rhamnus* cf. *gaudinii* HEER.

Husnicioara open pit offers the opportunity to study a large exposure on 1.5 – 2 km. Due to the dinamic change-over pursuant of the coal mining, we found few fossil bearing deposits with macroflora, rich in individuals but poor in species. The Husnicioara open pit is situated 15 km eastward from Drobeta Turnu Severin (Mehedinţi district).

MATERIAL AND METHOD

The plants samples were collected from the roof of the IV-th coal seam represented by grey, massive clay with various thicknesses, from few centimetres up to 6 m. The fossil plants assemblages allowed to point out about 16 taxa, collected either from the sterile strata (foliar imprints and bracts, or from the coal seam witch yielded branches and stems.

The fossil plants originated from the roof of the coal seam IV of the Husnicioara open pit (Mehedinti district), where DIACONU (2000) pointed out the following taxa: *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK, *Glyptostrobus europaeus* (BRONGNIART) UNGER, *Glyptostroboxylon tenerum*, *Salix ştefănescui* LAURENT & MARION, *Salix* sp., *Potamogeton* cf. *nodosus* POIR, *Phragmites oeningenussis* AL. BRAUN, *Ceratophyllum* sp. aff. *C. demersum* LINNÉ, *Quercus* sp. and *Acer* sp. The first two species form sometimes huge accumulations of leaves, proving their autochthony and importance in forming the parental vegetal material (PVM) of the coals.

Later, but above the coal seam VI (DIACONU, 2002a) stressed out the following species: *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK and *Glyptostrobus europaeus* (BRONGNIART) UNGER. In recent works (DIACONU & TICLEANU, in press) were discovered in the adjacent areas of the coal seam IV three species of *Pandanus*, and above the coal seam VI *Carya denticulata* (WEBER) ILJINSKAIA, *Platanus platanifolia* (ETTINGSHAUSEN) KNOBLOCH and *Carpinus betulus* LINNÉ.

The deposits of the coal seam IV of the Husnicioara open pit, (PETRESCU et al., 1989) were also described from the palynological point of view. The palynological works lead to the following conclusions: arctotertiary elements (*Sciadopitys*, *Picea*, *Tsuga*, *Pinus* s. *diploxylon*, *Carpinus*, *Fagus*, *Ulmus*, *Compositae* etc.) and intermediate ones (*Cedrus*, *Carya*, *Pterocarya*, *Zelkova* etc.) are dominant, but the warm loving representatives (*Myrica*, *Reevesia*) are rather rare.

RESULTS AND DISCUSSIONS

Family TAXODIACEAE

Genus **G l y p t o s t r o b u s** ENDLICHER

Glyptostrobus europaeus (BRONGNIART) UNGER (Pl. I, fig. 1a, 1b)

Material: samples HS - 1 – 10, from the coal seam I and roof of coal seam IV.

Description: imprints and casts of deciduous stem fragments covered with scaly corkscrew leaves. The leaves are truncated with acute apex, covering each other like the fish scales.

Observations: it should be specified that the deciduous stems are identical with the ones illustrated by GIVULESCU (1973).

Occurrence: this taxon is widespread in the fossil floras of Romania, as mentioned by TICLEANU & DINULESCU (1998). *Glyptostrobus europaeus* is a tree frequent in the Neogene of Romania, mostly in coal deposits. It reached its maximum development in the Early Pliocene, when it participated in wide swamps.

The nearest living relative: *G. pensilis* (STOUNT) KOCH, a 30 m height tree, a termophyllous and hygrophytic species from the southeastern part of China.

Family CERATOPHYLACEAE

Genus **C e r a t o p h y l l u m** LINNAEUS

Ceratophyllum sp. aff. *C. demersum* LINNÉ (Pl.I, fig. 2)

Material: one sample (HS-112) from the roof of the coal seam IV.

Descriptions: imprints of the linear double ramified laminae with attenuated apex and variable lengths, between 15 and 20 mm.

Occurrence: The taxon was firstly described in the paleoflora of Chiuzbaia (GIVULESCU 1990, p. 50)

The nearest living relative: *Ceratophyllum demersum* L., an aquatic plant, which lives in fresh waters.

Family PLATANACEAE

Genus **P l a t a n u s** LINNAEUS

Platanus platanifolia (ETTINGSHAUSEN) KNOBLOCH (Pl. I , fig. 4)

Material: one sample (HS-116) from the clayey intercalation between the coal seam VI and VII.

Description: the leaf is asymmetric, webbed lobed, with a rounded base and a rare, irregular dentate margin. The venation is of basal actinodromous type, with the primary vein straight and two opposed lateral erect veins. From the primary vein the opposed secondary veins diverge ending in the teeth from the margin of the leaf.

Occurrence: this is a rare taxon in Europe, exceptionally found in the Chiuzbaia paleoflora.

The nearest living relative: *Platanus occidentalis* L., a 25 m height tree, from North America, widespread through mesophytic forests of the west and south part of Mississippi Valley, preferring wet soils from river meadows with forests rich in species.

Family BETULACEAE

Genus **C a r p i n u s**

Carpinus betulus LINNE – bract (Pl. I, fig. 3)

Material: one sample, HS-117, from the roof of the coal seam I.

Descriptions: imprint of a trilobate bract; only two lobes are preserved, with the main lob prominent and dentate margin, without apex and weakly preserved. The lateral lobe has an oblique position, and the sinus between the lobes is acute and little dredged. The venation is fan like, with a clear primary vein broken trough the median lobe, which together with the secondary veins form rectangular net-eyes specifically to this species.

Observations: based on its typical characteristics, this bract was attributed to *C. betulus* (GREGOR 1986, fig. g, j, k, l) but it was described like *C. pyramidalis* (GOEPP.) HEER.

Occurrence: it is a widespread species in the European Mio-Pliocene. From Romania it is mentioned in Pontian deposits in Chiuzbaia (GIVULESCU 1990) and Lugoj Basin (ȚICLEANU & PARASCHIV 2001).

The nearest living relative: *Carpinus betulus* L. presents a clearly looking-like with the fossil species.

Carpinus betulus LINNÉ - leaves. (Pl. I, fig. 7)

Material: one sample, HS-120, a foliar imprint from the roof of the coal seam I.

Description: the imprint of a leaf fragment with dentate margin. The venation is pinnate, with a strong primary vein, from which diverge secondary straight veins, ending in the teeth of the leaf margins.

Observation: even if we have a single leaf fragment, this sample might be compared with the ones described and figured by ȚICLEANU & PARASCHIV 2001 (p. 367, Pl. IV, fig. 1).

Occurrence: it is a frequent species in the Romanian Neogene deposits. It was described in Pontian deposits of the Lugoj Basin (ȚICLEANU & PARASCHIV 2001).

The nearest living relative: *C. betulus* L., a widespread species through the Europe forests and from the Iberian Peninsula. In the northern part of the Europe the species is spread till Denmark and extreme southern Sweden arrea and in south is found until Anatolia. *C. betulus* prefers humid and chill places or shadowy slopes.

Family MYRICACEAE

Genus **M y r i c a LINNAEUS**

? *Myrica lignitum* (UNGER) SAPORTA (Pl. I, fig.6)

Material: one sample, HS-118, from the roof of the coal seam IV.
Description: the imprint of an oblong leaf, narrow at the base, without apex and irregular dentate margin. The venation is pinnate-camptodromous, with the primary vein strongly marked, but whittled to the apex. The secondary veins are numerous, branched at the leaf margins. Trough the secondary veins there are inter-secondary shorter veins, which don't reach the leaf margin.
Observation: our sample was related carefully to *Myrica* genus, however it presents enough characters alike to the one described and figured as *M. lignitum* by GIVULESCU 1957 (p. 27, Pl. II, fig. 8) and ŢICLEANU & ARTIN 1982 (p. 177, Pl. I fig. 13; Pl. II, fig. 3).
Occurrence: the species is widespread in the European Tertiary, beginning with the Oligocene until the Middle Miocene. In Romania it was cited from Borsec by POP (1936) who specified that it is a rare presence in the Pliocene deposits. It appears also in Sarmatian deposits in Deva-Tampa (ŢICLEANU & ARTIN 1982) and in Pontian deposits in Luncşoara (Bihor) and Cornitel (GIVULESCU 1951, 1957).
The nearest living relative: *M. californica* CHAM. et SCH. from North America.

Family FAGACEAE
Genus **Q u e r c u s** LINNAEUS
Quercus sp. (Pl. II, fig. 1)

Material: one sample (HS-111) from the roof of the coal seam IV.
Description: a leaf fragment, which typically respect the characters of the genus.

Family JUGLANDACEAE
Genus **C a r y a** NUTTAL
Carya denticulata (WEBER) ILJINSKAIA (Pl. I, fig. 5a, 5b)

Material: samples HS-112-115, from the clay interbedding between the roof of the coal seam VI and VII.
Description: the imprints of some variable leaves, narrowly elliptic or narrowly oblong, asymmetrical, with acute apex and asymmetrical, slowly cordate base. The margin is serrate, with oblique teeth, straight oriented. The venation is pinnate-semicraspedodromous type, with the primary vein curved, strong, whittled to the apex, the secondary veins are numerous and anastomosing nearly to the leaf side.
Observations: our samples are distinctly by the one described by GIVULESCU 1990 (p. 102, Pl. 17, fig. 5, 8) in the L/1 ratio, which has bigger values than our ones.
Occurrence: the species is not so widespread through the European Mio-Pliocene. In Romania appears in the Upper Miocene to the Pliocene deposits, for the last time being mentioned in Borsec (Pop 1936).
The nearest living relative: GIVULESCU (1990) considers that this taxon has some similitude with *Carya tomentosa, C. amara* and *C. ovata. Carya* represents trees with more than 25 m (even 40 m height). *Carya* is frequently found in the mesophytic deciduous forests from the United States of America.

Family STERCULIACEAE
Genus **B y t t n e r i o p h y l l u m**
Byttneriophyllum tilliaefolium (AL. BRAUN) KNOBLOCH & KVACEK (Pl. II, fig. 2a, 2b, 3, 4, 5)

Material: samples HS-11-108 from the roof between the coal seam IV and VI, and HS – 109, 110 from the roof of the coal seam IV.
Description: imprints of leaves with palmed venation, entire marginated and with weakly cordate base. The petiole is normally, with about 2.5 cm length. The venation is palmed-captodromus, with lateral veins from which secondary veins diverge, united by a net of tertiary veins.
Observations: the species is in a great number in the Husnicioara open pit, being a coal forming taxa.
The nearest living relative: This taxon is exclusively fossil (ŢICLEANU 1982, 1989) and represent a common ancestor of the modern genera *Tarrietia* and *Buttneria* from the Indochina Peninsular regions. *B. tiliaefolium* was a tree that gave an impressive quantity of vegetal material during coal accumulation in the Early Sarmatian - Middle Romanian time span, including the Dacian-Romanian deposits from Danube-Motru area.

B. tiliaefolium was a tree exceeding 25 m in height and formed pure paleophytocoenoses (TICLEANU 1992), and sometimes vegetating in association with *Glyptostrobus europaeus*; the fossil remains of these two species founded together prove for that.

Family SALICACEAE
Genus **S a l i x** LINNAEUS
Salix sp. (Pl. II, fig. 6, 7, 8)

Material: samples HS – 119 – 112 from the roof of the coal seam IV and the clayey intercalation between the coal seam VI and VII.
Description: leaves of oblong-lanceolate form, 7-9 times long then wide, narrow base, entire marginated and acuminate apex. From the primary vein diverge curved secondary veins, which end on the margins. The secondary veins form a net, being disposed almost perpendicularly to the leaf axes.
Observations: because of the large variability of the *Salix* leaves, the identification to species level is very difficult.

Family PANDANACEAE
Genus **P a n d a n u s**
Pandanus austriacus ETTINGSHAUSEN (Pl. III, fig. 1)

Material: samples HS – 123, 124 and 125.
Description: imprints of fragmented leaves (the same at all *Pandanus* species), the length is not estimable and the wide varies between 10 and 30 mm. The identified samples derive from linear leaves, with spiny-dentate margins; the teeth are curved to the leaf apex, have about 2 mm in length and are disposed at 10-20 mm distance one each other.
Observation: the identified specimens are alike to those described and figured by de PETRESCU & DUȘA 1982 (p. 115, Pl. X, fig. 1).
Occurrence: it is a frequent species in the Austrian Upper Cretaceous deposits. In Romania it was mentioned (PETRESCU & DUȘA, 1982) in the Upper Cretaceous deposits from Nocea and Ciotorogu (Rusca Montana).

Pandanus trinervis ETTINGSHAUSEN (Pl. III, fig. 2)

Material: samples HS – 126, 127.
Description: fragments of linear leaves of 25-35 mm wide, the two lateral shortcuts outlining themselves on the each side of the median vein. The secondary veins, parallel and very fine, are disposed like perfect parallel shortcuts at 0.5 – 1 mm distance between them, and to the leaf margin they almost overlap. The margin is fin serrate-dentate, with dense serration, having 3-5 teeth on 1 cm length.
Observations: the identified specimens are looking-like with the ones described and figured by PETRESCU & DUȘA 1982 (p. 116, Pl. IX, fig. 1).
Occurrence: this is another species frequent in the Austrian Upper Cretaceous deposits. In Romania it was mentioned in deposits of same geological age in Nocea and Rusca (PETRESCU & DUȘA 1982).

Pandanus barbui PETRESCU & DUSA (Pl. III, fig. 3)

Material: samples HS – 128, 129 and 130.
Description: the leaves of this species are different in concerning their margins, having the spiny teeth easily cambered to the base, acute to the apex and oriented to the leaf apex. The secondary veins are parallels and disposed closely one to each other.
Observations: the identified specimens are looking-like the ones described and figured by PETRESCU & DUȘA 1982 (p. 118, Pl. X, fig. 2, 3, 4).
Occurrence: the species was pointed out for the first time in Romania in the Upper Cretaceous deposits in Rusca (Rusca Montana).
Observation: the *Pandanus* species are woody plants, shrubby or liana, the majority being specifically to the mangrove vegetation. The genus *Pandanus* is represented in the actual flora about 630 species and it is spread in southeastern Africa, Madagascar, south and southeastern Asia, until Australia (PETRESCU & DRAGASTAN 1981).

CONCLUSIONS

Through these researches we identified the following taxa: *Glyptostrobus europaeus* ((BRONGNIART) UNGER, *Ceratophyllum* sp. aff. *C. demersum* LINNÉ, *Platanus platanifolia* ETTINGSHAUSEN) KNOBLOCH, *Carpinus betulus* LINNÉ, - leaves, *Carpinus betulus* LINNÉ, – bracts, ?*Myrica lignitum* (UNGER) SAPORTA., *Quercus* sp., *Carya denticulata* (WEBER) ILJINSKAIA, *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK, *Salix* sp., *Pandanus austriacus* ETTINGSHAUSEN, *P. trinervis* ETTINGSHAUSEN, *P. barbui* PETRESCU & DUȘA, *Ph. oeningensis* AL. BR.

Most of these taxa are included in the dominant group of the coal swamps, but the presence of three *Pandanus* species is pointed out for the first time in Romania, this genus being an Oligo-Miocene relict. The same genus was mentioned by PALAMAREV & UZUNOVA (1969) from the Bulgarian Pliocene deposits. Our findings document the most northern area of this relict, proving that this species is a Carpathian relict, not only a Balkan one.

MAI (1995) stresses out that the *Pandanus* was frequently found in the Miocene in association with: *Carex, Cladium, Cyperus, Dulchium, Eleocharis, Scirpus, Phragmites*, Zingiberaceae, Spirematospermum, Typhaceae, Sparganaceae, Alistmatacee, Butomaceae, Onagraceae, *Decodon, Oenanthe,* Osmundaceae and Brasseniaceae. Ticleanu found these species in the Pliocene flora of Oltenia. GREGOR (1976) associated *Pandanus* species to the "Monocotyledonatae Facies", forming "herbaceous marsh and reeds".

The discovery of *Pandanus* ssp. in the Getian deposits of the Husnicioara open pit, a very well known termophyllous representative, confirmed the annual average of temperature higher than 15^0 C during the Getian time. Another evidence for this hypothesis is the presence of other threes, as important termophyllous species: *Glyptostrobus europaeus*, *Byttneriophyllum tiliaefolium* and, probably, *Myrica lignitum*, the last one being to its last occurrence. This fact is very important for reconstructing the mean annual temperature (MAT) in Dacian.

It is noticeable that in more than 227 fossil leaves deposits from the Jiu-Motru Formation (Parscovian-Romanian), identified by ȚICLEANU (1992 a, b), there were not found any remains of *Pandanus* or *Myrica*, probably because of the annual average of temperature lower than 15^0 C. *G. europaeus* and *B. tiliaefolium,* even if they are termophyllous species, could vegetate at annual average of temperature lower than 14^0 C.

After MAI (1995) the *Pandanus* lives at MAT between 15 and 20^0 C, in tropical-subtropical climate specifically to the SE Asia.

As conclusion, the Getian climate was characterized by precipitations of about 1400 mm/year, almost uniform distributed, having a peak in the summer and MAT higher than 15^0. These values chime with the humid subtropical

climate type (after the Koppen's system of classification, see STRAHLER 1973), specifically to the SE China and the southeastern part of North America. During the Parscovian-Middle Romanian it was recorded a lower MAT than 15^0C, maybe to 14^0C, but the precipitations had not recorded some noticeable changes, so the climate type was the same, increasing the development of the coal forming flora and vegetation.

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PLATE I

1a. *Glyptostrobus europaeus* (BRONGNIART) UNGER (cast)

1b. *Glyptostrobus europaeus* (BRONGNIART) UNGER (imprint)

2. *Ceratophyllum* sp. aff. *C. demersum* LINNÉ

3. *Carpinus betulus* LINNÉ – bract

4. *Platanus platanifolia* (ETTINGSHAUSEN) KNOBLOCH

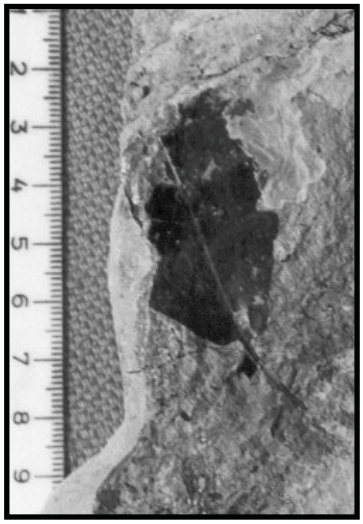
5a. *Carya denticulata* (WEBER) ILJINSKAIA, *Salix* sp. (imprint)

6. ?*Myrica lignitum* (UNGER) SAPORTA

7. *Carpinus betulus* LINNÉ

5b. *Carya denticulata* (WEBER) ILJINSKAIA, *Salix* sp. (cast)

PLATE II

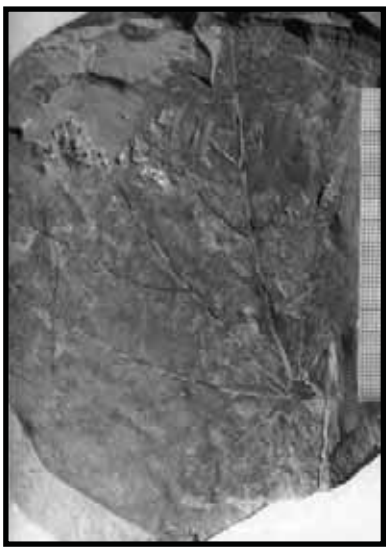


1. *Quercus* sp.

2a. *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK (imprint)

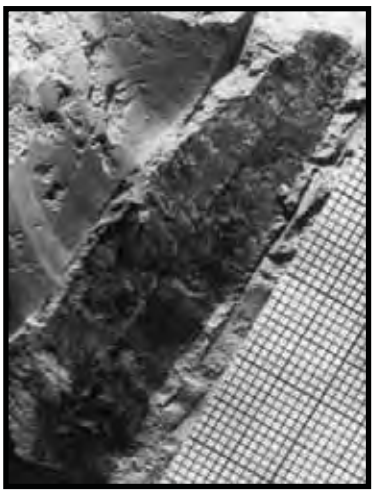
2b. *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK (cast)

3. *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK



4. *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK

5. *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBLOCH & KVACEK



6. *Salix* sp. (str. VI-VII)

7. *Salix* sp. (str. VI-VII)

8. *Salix* sp. (str. IV)

PLATE III

1. *Pandanus austriacus* ETTINGSHAUSEN

2. *P. trinervis* ETTINGSHAUSEN

3. *P. barbui* PETRESCU & DUȘA

4. *Potamogeton* cf. *nodosus* POIRET
(imprint – cast)