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A PRELIMINARY REPORT ON THE LOWER MIOCENE LEAF FLORA FROM THE BROWN COAL MINE "BEŁCHATÓW" (CENTRAL POLAND)*

Wstępne doniesienie o dolnomioceńskiej florze liściowej z Kopalni Węgla Brunatnego "Bełchatów"

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ABSTRACT. This study deals with plant remains, chiefly leaves, from a layer of clays overlying the paratonstein layer TS-3 (vel TS-4) in Brown Coal Mine "Bełchatów", dated by the fission track method at 18.1±1.7 Ma (Burhart 1985). Leaf specimens preserved as impressions and compressions were identified using the morphological-comparative method and cuticular analysis. The plant remains determined belonged to the families Aceraceae, Altingiaceae, Betulaceae, Cupressaceae, Fagaceae, Hydrocharitaceae, Juglandaceae, Lauraceae, Myricaceae, Nyssaceae, Osmundaceae, Pinaceae, Salicaceae, Smilacaceae, Taxodiaceae, Ulmaceae.

KEY WORDS: Flora, vascular plants, Lower Miocene, brown coal, fission track method

INTRODUCTION

Thirty-five years have passed since the discovery of brown coal at Bełchatów in Central Poland (Fig. 1) in 1960. Palaeobotanic studies were first based on palynological analyses of particular samples taken from drilling cores (Raniecka-Bobrowska 1962, Grabowska et al. 1963, Ziembińska-Tworzydło 1966 etc.). In the eighties multidirectional palaeobotanical studies of the Bełchatów deposits were started and the study of pollen profiles was complemented with analysis of macrofossils (Stuchlik et al. 1990). The present paper gives the preliminary results of a study of leaf remains and accompanying carpological remains found in the clay layer overlying the layer of TS-3 (vel TS-4) paratonstein. The state of preservation of leaf remains permitted the extraction of whole leaves or their large fragments from the deposit and the application of cuticular analysis.

LOCATION OF THE LEAF FLORA IN THE GEOLOGICAL PROFILE

The grey clay in which the plant remains were found overlies the paratonstein TS-3, localized in the geological profile of the Bełchatów deposits by Szynkiewicz (In: Stuchlik et al. 1990, fig. 6). As a result of the latest studies carried out by Czarnecki et al. (1992) this paratonstein has been designated as TS-4 and its age determined by the method of fission track dating (FT) at 18.1±1.7 Ma (Burchart 1985) (probably Ottnangian). The layer of grey clay with fossil flora lies between the main coal seam and coal seam III, denoted by "C" (Stuchlik et al. 1990, fig. 6).

The geological position of the site from which the study material was obtained is illustrated on the Fig. 2

COMPOSITION OF FOSSIL FLORA

The results of preliminary studies are presented in Table 1. A total of 230 specimens of plant remains have been prepared, four of

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Fig. 1. Location of the Brown Coal Mine "Bełchatów" (▲) in Poland

which are fern leaflets from the family Osmundaceae (Pl. 2, fig. 5). Conifers are represented by 13 specimens of needles, shoots, seeds and cones of taxa belonging to the families Pinaceae (Pl. 1, fig. 2), Taxodiaceae and Cupressaceae (Pl. 1, fig. 4). Angiosperms dominate in this flora, and among them dicotyledons from the following families: Aceraceae, Altingiaceae, Betulaceae, Fagaceae, Juglandaceae, Lauraceae, Myricaceae, Nyssaceae, Salicaceae, Ulmaceae. As regards monocotyledons, leaf remains of Smilacaceae and a large number of seeds of *Stratiotes kaltennordheimensis* (Zenker) Keilhack from Hydrocharitaceae have been distinguished. Dominant are the leaf remains of *"Castanea"* sp. (Pl. 1, fig. 5; Pl. 2, fig. 3), *"Castanea" kubinyi* Kovats ex Ettingshausen sensu Knobloch et Kvaček (1976) (Pl. 2, fig. 1–2), *Daphnogene polymorpha* (Al. Braun) Ettingshausen (Pl. 1, fig. 1, 6) and *Acer integrilobum* O. Weber (Pl. 2, fig. 6). The remaining taxa are represented by single specimens, e.g. *Alnus julianaeformis* (Sternberg) Kvaček et Holý (Pl. 1, fig. 8), *Laurophyllum pseudoprinceps* Weyland et Kilpper (Pl. 2, fig. 4), *Myrica lignitum* (Unger) Saporta (Pl. 1, fig. 3), *Quercus rhenana* (Kräusel et Weyland) Knobloch et Kvaček (Pl. 1, fig. 7).

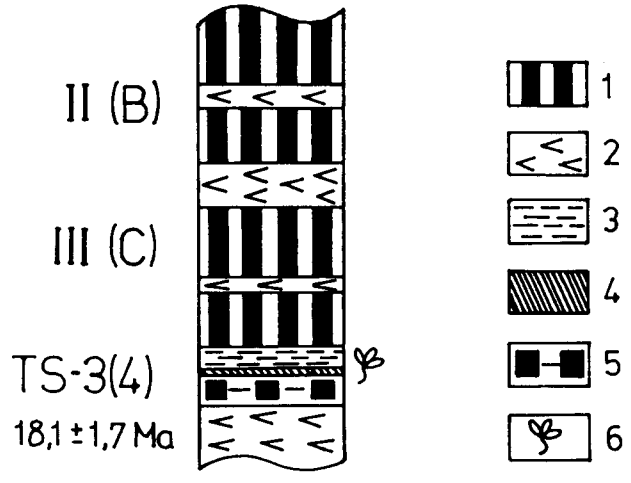

Fig. 2. Geological profile of the site with fossil flora above paratonstein layer TS-3 (vel TS-4) (after Szynkiewicz (1994) unpubl., considerable simplified). 1 – xylite brown coals (with numbers of coal seams), 2 – lacustrine limestones, 3 – grey clay with fossil flora, 4 – paratonstein layer TS-3 (vel TS-4), 5 – sapropelic coals, 6 – fossil flora

PICTURE OF VEGETATION

Plant remains occurring in the taphocenosis under study were derived from plant communities of Mixed Mesophytic forest et swamp forest. The former was dominated by trees of *"Castanea"* sp., *"Castanea" kubinyi* Kovats ex Ettingshausen sensu Knobloch et Kvaček and shrubs of *Daphnogene polymorpha* (Al. Braun) Ettingshausen and *Laurophyllum pseudoprinceps* Weyland et Kilpper from the family Lauraceae. Deciduous taxa (*Acer, Carya, Liquidambar, Populus, Ulmus*) and conifers (*Pinus, Tetraclinis*) were also abounded in the tree layer. Ferns (*Osmunda*) grew in the herb layer and *Smilax* as climber. Particularly wet places were grown over by swamp forest with *Taxodium*, *Glyptostrobus*, *Nyssa*, *Myrica*, and probably *Alnus* and besides, *Quercus rhenana* (Kräusel et Weyland) Knobloch et Kvaček. This forest must have bordered upon some water body, for there were many seeds of *Stratiotes* found here, the plant floating on water surface.

These types of forests were common in the Tertiary of Europe (Mai 1995). At present Mixed Mesophytic forests occur in south-eastern Asia (Wang 1961). Swamp forests resembling the fossil ones grow in the south-eastern states of the USA (Mississippi Delta and Florida) (cf. Podbielkowski 1987).

The Arctotertiary element is dominant in the taphocenosis under study, whereas the palaeotropical element is represented by taxa *Daphnogene polymorpha* (Al. Braun) Etting-

Table 1. List of macrofossils determined from grey clay of TS-3 (vel TS-4) dated on 18.1±1.7 Ma in Brown Coal Mine "Bełchatów". (Abbreviations: c – cone, f – fruit, l – leaf, lt – leaflet, n – needle, s – seed, tw – twig)

Taxon	Type of remain	Number of specimens
Osmundaceae		
Osmunda parschlugiana (Unger) Andreánszky	lt	4
Pinaceae		
Pinus cf. *hampeana* (Unger) Heer	c	2
Pinus sp. 1	n	4
Pinus sp. 2	s	1
Taxodiaceae		
Glyptostrobus europeus (Brongniart) Unger	tw	4
Taxodium dubium (Sternberg) Heer	tw	1
Cupressaceae		
Tetraclinis salicornioides (Unger) Kvaček	tw	1
Dicotyledones		
Myricaceae		
Myrica lignitum (Unger) Saporta	l	7
Juglandaceae		
? *Carya serraefolia* (Goeppert) Kräusel	lt	3
Salicaceae		
Populus sp.	l	1
Betulaceae		
Alnus julianaeformis (Sternberg) Kvaček et Holý	l	9
Fagaceae		
"Castanea" kubinyi Kovats ex Ettingshausen sensu Knobloch et Kvaček	l	36
"Castanea" sp.	l	82
Quercus rhenana (Kräusel et Weyland) Knobloch et Kvaček	l	4
Quercus cf. *cerrisaecarpa* Kolakovski	f	3
Altingiaceae		
Liquidambar sp.	f	1
Ulmaceae		
Ulmus sp.	l	1
Lauraceae		
Daphnogene polymorpha (Al. Braun) Ettingshausen	l	20
Laurophyllum pseudoprinceps Weyland et Kilpper	l	2
Aceraceae		
Acer integrilobum O. Weber	l	19
Acer cf. *integrilobum* O. Weber	l	6
Acer sp. 1	l	1
Acer sp. 2	f	1
Nyssaceae		
Nyssa ornithobroma Unger	s	1
Dicotyledones incertae sedis		
Dicotylophyllum sp. 1	l	2
Dicotylophyllum sp. 2	l	1
Monocotyledones		
Smilacaceae		
Smilax hastata (Brongniart) Saporta	l	2
Hydrocharitaceae		
Stratiotes kaltennordheimensis (Zenker) Keilhack	s	2
Indeterminate		9
Total		230

shausen and *Laurophyllum pseudoprinceps* Weyland et Kilpper.

It should be added that some bone remains were also found in the same site. They have been identified by Prof. K. Kowalski from the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences in Kraków as teeth of a fruit-eating bat from suborder Megachiroptera, approximate to the genus *Rousettus* (Kowalski 1995). Bełchatów is now the northernmost locality of Megachiroptera in the world. According Kowalski's (1995) opinion, the occurrence of Megachiroptera at Bełchatów, indicates that a mild intertropical climate prevailed at the time when the brown coal seams were being formed.

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PLATES

Plate 1

Daphnogene polymorpha (Al. Braun) Ettingshausen

1. Specimen KRAM-P 214/9, leaf fragment, × 3
6. Specimen KRAM-P 214/39, leaf, × 3

Pinus sp. 1

2. Specimen KRAM-P 214/16, needle, × 5

Myrica lignitum (Unger) Saporta

3. Specimen KRAM-P 214/44, leaf fragment, × 3

Tetraclinis salicornioides (Unger) Kvaček

4. Specimen KRAM-P 214/20, twig, × 5

"*Castanea*" sp.

5. Specimen KRAM-P 214/37, leaf fragment, × 3

Quercus rhenana (Kräusel et Weyland) Knobloch et Kvaček

7. Specimen KRAM-P 214/18, leaf

Alnus julianaeformis (Sternberg) Kvaček et Holý

8. Specimen KRAM-P 214/28, leaf

Phot. A. Pachoński

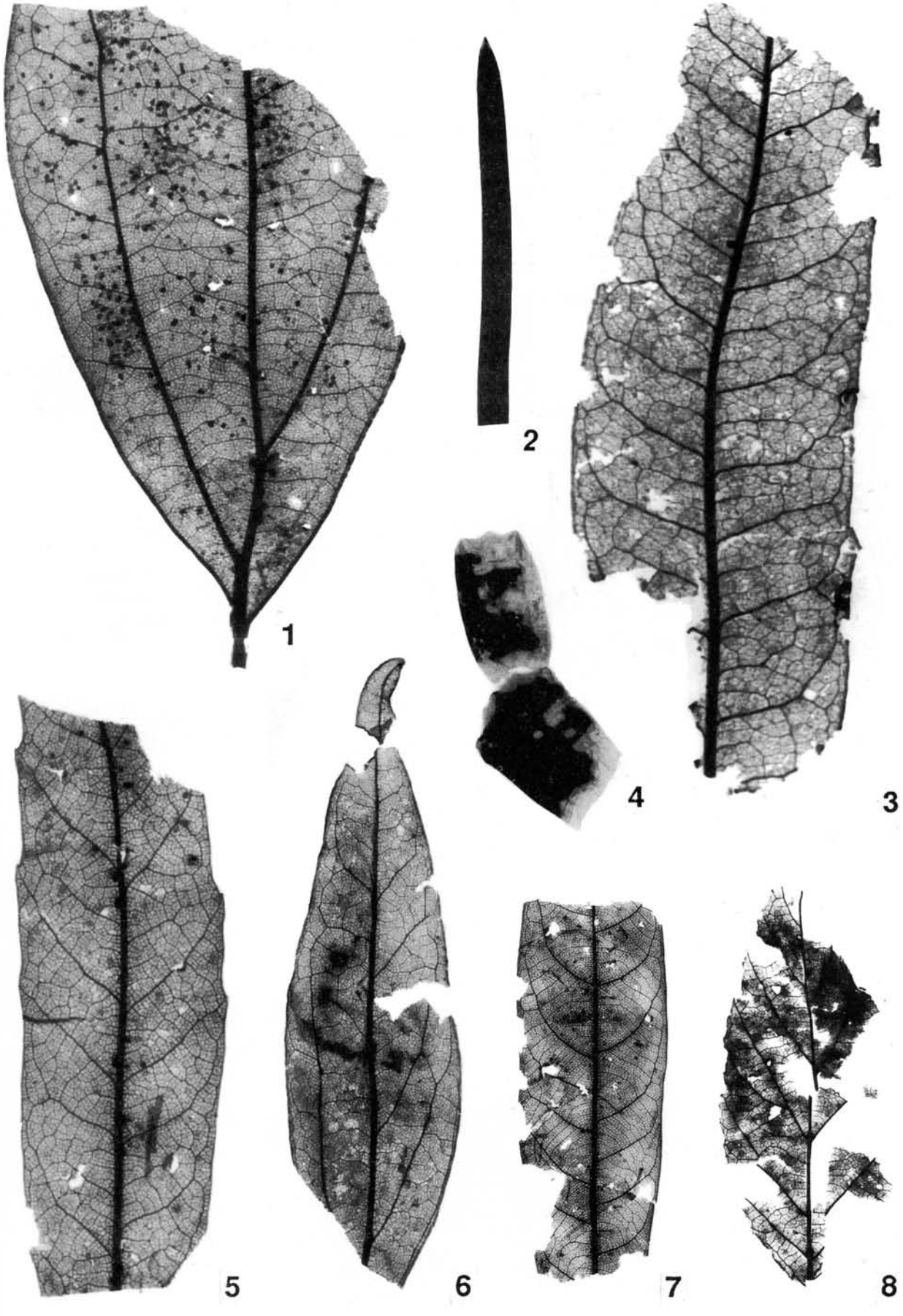
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Plate 2

"Castanea" kubinyi Kovats ex Ettingshausen sensu Knobloch et Kvaček

1. Specimen KRAM-P 214/29, leaf fragment, × 3
2. Specimen KRAM-P 214/27, leaf

"Castanea" sp.

3. Specimen KRAM-P 214/38, leaf fragment

Laurophyllum pseudoprinceps Weyland et Kilpper

4. Specimen KRAM-P 214/40, leaf fragment, × 3

Osmunda parschlugiana (Unger) Andreánszky

5. Specimen KRAM-P 214/36, leaflet fragment, × 5

Acer integrilobum O. Weber

6. Specimen KRAM-P 214/53, leaf fragment, × 3

Phot. A. Pachoński

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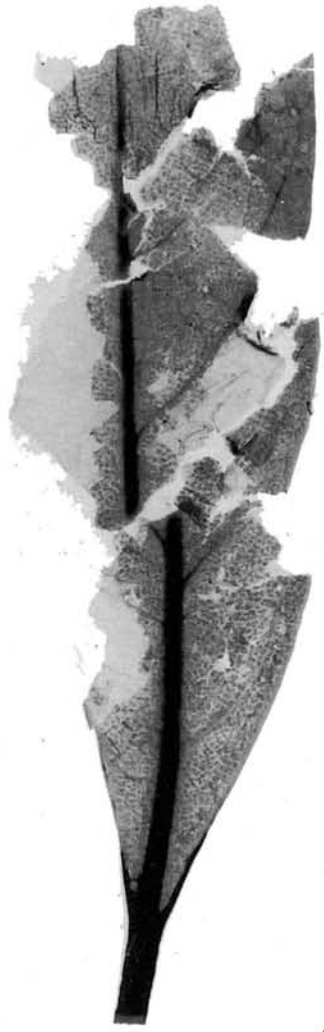

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