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NEW DATA ABOUT PLANT MACROFOSSILS IN THE MIDDLE MIOCENE LIMESTONES AT MŁYNY NEAR CHMIELNIK (Central Poland)

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ABSTRACT. New materials collected from detrital Middle Miocene limestones in the village of Młyny near Chmielnik made it possible to add the following taxa to the floristic list of this locality: Cupressaceae gen., *Alnus cecropiaefolia* (Ett.) Berger, *Platanus platanifolia* (Ett.) Knobloch, *Salix* sp. (impression of a fruit), *Crataegus* sp., *Viscum miquelii* (Geyler et Kinkelin) Czeczott, cf. *Ampelopsis* sp. New investigations of nannoplancton from the Chmielnik Formation (Dudziak & Łaptaś 1991) has changed the age of the fossil flora of Młyny from Sarmatian to Badenian (coccolitic zone NN 5–6).

KEY WORDS: leaf flora, detrital limestones, Middle Miocene

INTRODUCTION

Plant macrofossils were discovered in the Middle Miocene limestones in the Chmielnik region by Prof. J. Rutkowski in the 1960. The fossil materials collected then and in succeeding years were studied and the results published by Zastawniak (1980). The materials came from three limestone outcrops, two at Młyny (Młyny 164 and 165) and one at Stawiany. Further materials, mainly from the exposure at Młyny 164 (Zastawniak 1980: Fig. 2), were collected by J. Rutkowski in 1978 (48 specimens) and by E. Zastawniak and G. Worobiec in 1993 (127 specimens). These examples occurred in the same layer of micritic limestones of the Chmielnik Formation from which the leaf flora was described earlier (Zastawniak 1980).

The age of the Chmielnik Formation on the southern margin of Świętokrzyskie Mts. has been established for Upper Badenian – Lower Sarmatian (Rutkowski 1976, Alexandrowicz et al. 1982). New investigations of nannoplancton of a few sediment samples from this Formation (Dudziak & Łaptaś 1991) show the close relationship to the coccolitic zone NN5–6 (Badenian) in the Parathetis litostratigraphic scheme.

A total of 175 newly collected specimens were analysed. They are housed at the Palaeobotanical Museum, the W. Szafer Institute of Botany, Polish Academy of Sciences in Cracow, Nos KRAM-P 164/436–632. All the specimens have been preserved in the form of impressions, without any traces of plant tissue.

COMPONENTS OF ORICTOCENOSIS

Coniferae

Two specimens of the new material represent coniferous plants. One of them is a small fragment of a shoot, 1.5 mm wide, of a plant from the family Cupressaceae (Fig. 3:1), with opposite, short, scale-like leaves visible on it. The genera *Chamaecyparis*, *Cupressus* and *Thuja* have leaf shoots of this sort. A close determination on the basis of the morphology of a shoot, without any anatomical studies, is impossible.

The other specimen is an impression of a seed scale of pine (*Pinus*) with seed wings clearly visible (Fig. 1: 21). In the whole of the Młyny flora only these two families of conifers, i.e. Abietaceae and Cupressaceae, were represented in the remains found.

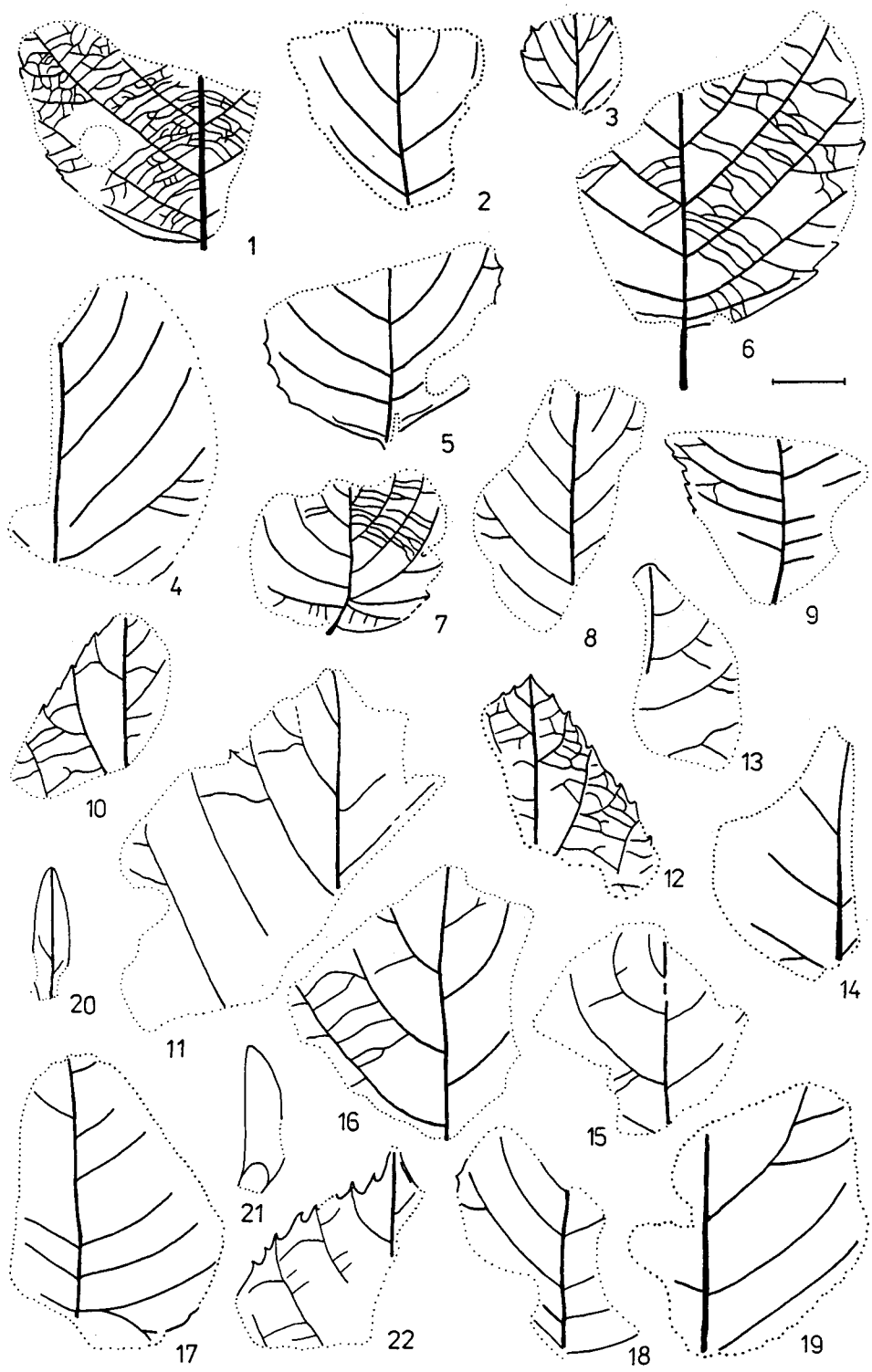

Fig. 1. Impressions of macrofossils of plants, chiefly leaves, from the exposure at Młyny (scale corresponds to 1 cm): 1,5,6,7 – *Alnus cecropiaefolia* (Ett.) Berger, KRAM-P 164/615, 513/1, 616, 485; 3,8 – *Alnus* sp., KRAM-P 164/584, 612; 2,4,13–19 – *Populus* sp., KRAM-P 164/470, 620/2, 613, 586, 523, 591, 491, 630, 473/1; 9 – *Carya denticulata* (Weber) Iljinskaja, KRAM-P 164/489; 10,12 – *Platanus platanifolia* (Ettingshausen) Knobloch, twin impressions, KRAM-P 164/479, 483/1; 11 – *Platanus platanifolia* (Ettingshausen) Knobloch, KRAM-P 164/486; 20 – *Salix* sp., KRAM-P 164/481; 21 – *Pinus* sp., a seed scale, KRAM-P 164/451; 22 – Vitaceae, cf. *Ampelopsis* sp., KRAM-P 164/619/1

Angiospermae

Plant remains with vestiges of the venation typical of the Angiospermae prevail in the whole material. They are, for the most part, small indeterminable fragment of leaves. Some of them are, however, large and/or characteristic enough to make it possible to deter-

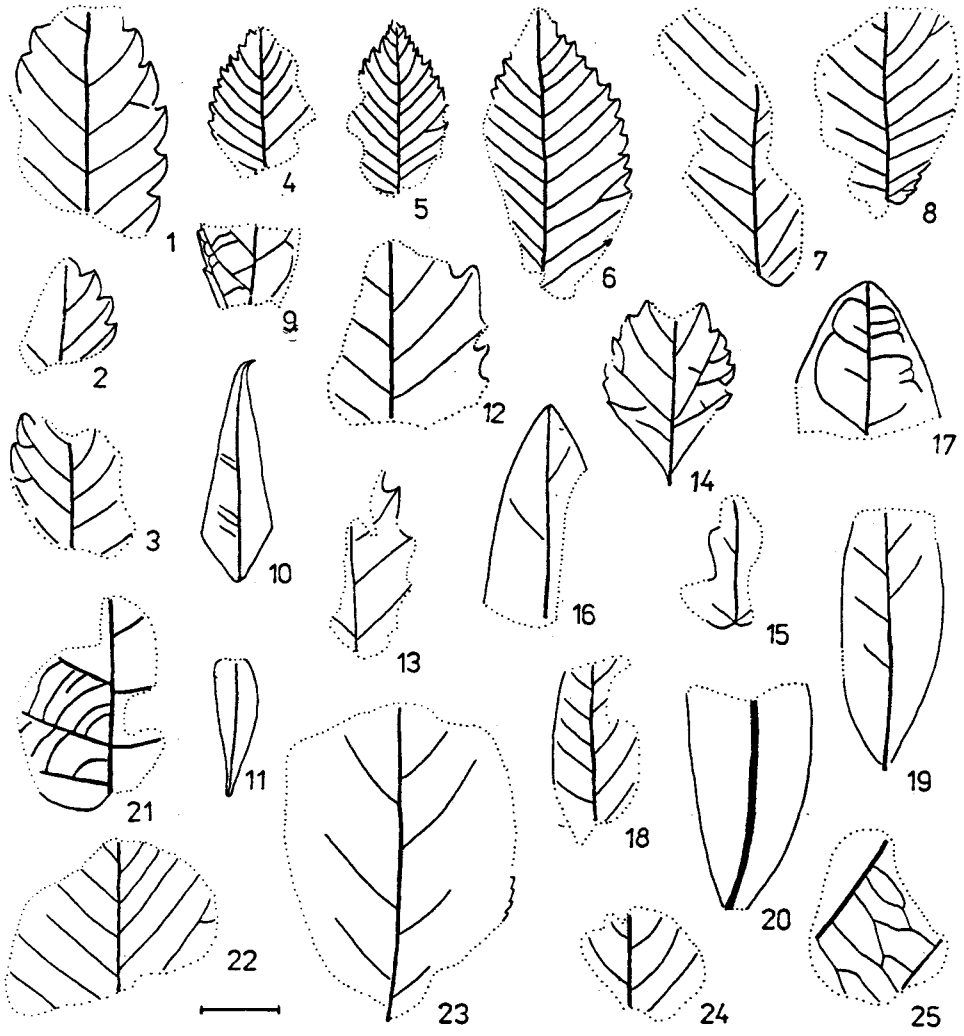

Fig. 2. Impressions of leaves from the exposure at Młyny (scale corresponds to 1 cm): 1–3 – *Zelkova zelkovaefolia* (Unger) Bůžek et Kotlaba, KRAM-P 164/488, 622, 507; 4–6,8 – *Ulmus plurinervia* Unger, KRAM-P 164/468, 473/2, 610, 632/1; 7 – *Ulmus* sp., KRAM-P 164/579/1; 9 – *Pterocarya paradisiaca* (Unger) Iljinskaja, KRAM-P 164/579/2; 10 – *Podocarpium podocarpum* (A.Braun) Herendeen, KRAM-P 164/619/2; 11 – *Viscum miquelii* (Geyler et Kinkelin) Czeczott, KRAM-P 164/619/3; 12 – *Quercus* aff.*pseudocastanea* Goeppert, KRAM-P 164/525; 13 – *Quercus* aff. *gigas* Goeppert, KRAM-P 164/571/1; 14 – *Crataegus* sp., KRAM-P 164/467; 15 – *Acer* aff. *campestre* L., KRAM-P 164/452; 16–20 – *Dicotylophyllum* sp.div. – Lauraceae type, KRAM-P 164/ 618, 483/2, 614, 476, 460; 21 – *Dicotylophyllum* sp., fragment of thick leaf, KRAM-P 164/620/2; 22 – Betulaceae vel Ulmaceae, KRAM-P 164/438; 23 – *Dicotylophyllum* sp., KRAM-P 164/617; 24 – *Dicotylophyllum* sp. (*Alnus* ?), KRAM-P 164/580; 25 – *Dicotylophyllum* sp. (*Platanus* ?), KRAM-P 164/571/2

mine at least the genus of a given tree or shrub and even its species. The remains of alder (*Alnus*) leaves were most numerous, 14 specimens altogether, of which 4 represent the fossil species *Alnus cecropiaefolia* (Ett.) Berger (Fig. 1: 1,5–7), previously recorded only from Stawiany (Zastawniak 1980). Another species new to the flora of Młyny, although known earlier also from Stawiany, is the fossil plane tree *Platanus platanifolia* (Ett.) Knobloch (Fig. 1: 10–12). Its leaves are generally very large, lobed, with characteristically toothed margins. Leaf fragments of this taxon can be distinguished by the third order venation typical of plane leaves. The remaining genera and species, viz. *Acer* aff. *campestre* L. (Fig. 2: 15), *Carya denticulata* (Weber) Iljinskaja (Fig. 1:9), *Hemiptelea* aff. *davidii* Hance (Fig. 3: 2, 4, 5), *Podocarpium podocarpum* (A. Braun) Herendeen (= *Podogonium oehningense, P. lyelianum*) (Fig. 2:10), *Populus* sp. (Fig. 1: 2, 4, 13–19), *Pterocarya paradisiaca* (Unger) Iljinskaja (Fig. 2: 9), *Quercus* aff. *pseudocastanea* Goeppert (Fig. 2: 12) and *Quercus* aff. *gigas* Goeppert (Fig. 2: 13), *Salix* sp. (Fig. 1: 20), *Ulmus plurinervia* Unger (Fig. 2: 4–6, 8) and *Zelkova zelkovaefolia* (Unger) Bůžek et Kotlaba (Fig. 2: 1–3, Fig. 3: 3) were already known from the fossil flora of Młyny. However, in the new materials, willow is represented not only

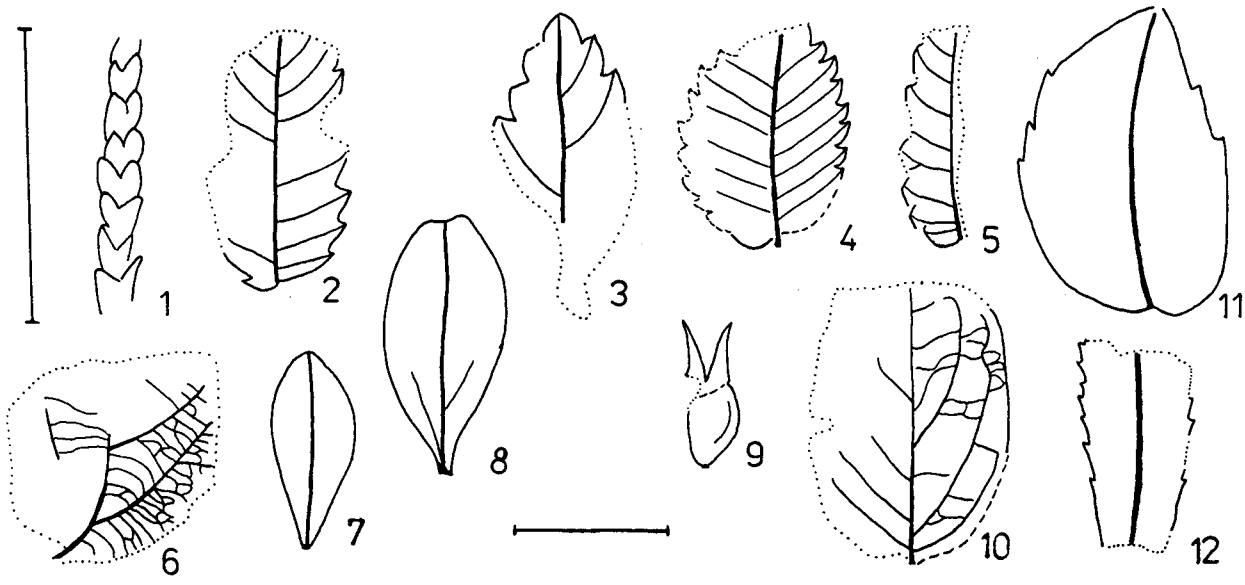

Fig. 3. Impressions of macrofossils of plants from the exposure at Młyny (scale corresponds to 1 cm): 1 – Cupressaceae, fragment of a shoot, KRAM-P 164/517; 2,4,5 – *Hemiptelea* aff. *davidii* (Hance) Planchon, KRAM-P 164/619/2, 484, 549; 3 – *Zelkova zelkovaefolia* (Unger) Bůžek et Kotlaba, KRAM-P 164/500; 6 – *Dicotylophyllum* sp. (*Alnus* ?), part of a small, volute leaf, KRAM-P 164/572; 7,8 – *Viscum miquelii* (Geyler et Kinkelin) Czeczott, KRAM-P, 164/495, 619/3; 9 – *Salix* sp., fruit impression, KRAM-P 164/488; 10,11 – *Dicotylophyllum* sp.div., Leguminosae type, KRAM-P 164/526, 487; 12 – *Phyllites* sp. (Monocotyledones?), KRAM-P 164/513

by the impression of a leaf but also by that of a fruit (Fig. 3: 9), the most reliable evidence of the presence of their genus in the fossil state.

One impression, almost complete, of a leaf of *Crataegus* (Fig. 2: 14), in addition to the genera *Pyracantha, Rosa, Rubus* and *Sorbus* determined before, proves the diversity of the Rosaceae shrubs in the orictocenosis of Młyny. Some of the leaf impressions belong to the so-called Leguminosae type (Fig. 3: 10, 11). They are small leaves with entire or toothed margins and are fairly numerous in the whole flora of Młyny (cf. Zastawniak 1980). The new materials comprise also impressions of elongate leaves with entire margins and only a very thick median vein visible, without any trace, or with only the slightest hint, of secondary venation (so-called Lauraceae type). Their mode of preservation and characters of venation are typical of plants, particularly shrubs, with leathery leaves (Fig. 2: 16–20).

A taxon completely new to Młyny is *Viscum miquelii* (Geyler et Kinkelin) Czeczott, a fossil species of mistletoe possessing small, oval leaves with entire margins, tapering to a form a short, broad petiole (Fig. 2: 11, Fig. 3: 7, 8). A fragment of another leaf bears characters typical of leaves from the family Vitaceae (Fig. 1: 22). It may have been a member of the genus *Ampelopsis* and indeed could conceivably be *Ampelopsis malvaeformis* (Schlotheim) Mai (= *A. tertiaria* Dorofeev), whose seed had previously been found at Młyny (Zastawniak 1980).

Remains of monocotyledonous plants are distinguishable at first sight by their regular parallel arrangement of leaf veins. The impressions of shoots and leaves of various genera, among them, *Cyperacites, Phragmites, Poacites* and *Typha* (cf. Zastawniak 1980) are grouped in abundant aggregations, the so-called "plant chaff" amid which can be seen, some impressions of marine molluscan shells (*Cardium*) whose presence indicates that they were deposited by the seashore, in places where vegetable material floated in coastal reed and rush swamps.

CONCLUSION

The mode of preservation of the plant remains in the deposit, grouped in abundant aggregations, proves the allochthonous nature of the Middle Miocene flora of Młyny, which means that this orictocenosis originated from an accumulation of plant material brought in from elsewhere. Because the impressions of leaves, whether from grassland communities or from trees and shrubs, are accompanied by

numerous impressions of shells of salt water molluscs, this accumulation must have taken place in a brackish environment. The plant material may have been transported not only by water currents but also by winds which carried leaves and light fruits (e.g. of willow) or winged seeds (e.g. of pine).

The new materials from Młyny support earlier statements about the composition and nature of the plant communities and the biotopic conditions of their occurrence. Such genera as *Alnus*, *Carya, Platanus, Populus* and *Pterocarya* provide evidence of the presence of deciduous forests which grew in moist habitats in the alluvial littoral zone. Somewhat drier places and the slopes of small elevations were overgrown by mesophilous deciduous forests containing maples (*Acer*) and *Zelkova* and shrubs, *Crataegus* and others with Lauraceae-type leaves amongst them. Creepers (cf. *Ampelopsis*) and parasitic mistletoe (*Viscum*) entwined the trees. Xerothermic thickets, typical of drier biotopes, grew on maritime sands and stony slopes and were made up of shrubs characterized by Leguminosae-type leaves. In places, these thickets passed into clear xerophytic woods with pine (*Pinus*) and oak (*Quercus*) and, in the group of lower trees, with elm (*Ulmus plurinervia*) and Cupressaceae. Reed-swamp communities with *Phragmites, Typha* and other monocotyledonous plants, occurred right by the edge of or in water.

A comparison of the climatic requirements of the plant genera identified in the orictocenosis from Młyny with those of modern plants indicates that they are now associated with the warm-temperate and temperate climates of the Holarctic. The over representation of small forms of leaves in this orictocenosis is indisputable, a fact which in paleoclimatology is sometimes interpreted as an indication of a drier climate (Dilcher 1973).

However, in the present case it may have been due to particular, not very favourable, biotopic conditions under which the trees and shrubs grew by the sea.

The fossil flora of Młyny is very similar to the Sarmatian macroflora of Stare Gliwice (Szafer 1961) as well as to the pollen flora of the sulfur-bearing (Badenian) deposits at Piaseczno, 60 km east of Chmielnik (Oszast 1967). The great similarity suggests the same climatic conditions for these three fossil floras (Zastawniak 1980).

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REFERENCES

ALEXANDROWICZ S.W., GARLICKI A. & RUTKOWSKI J. 1982. Podstawowe jednostki litostratygraficzne miocenu zapadliska przedkarpackiego. Kwart. Geol. 26(2): 470–471.

DILCHER D. L. 1973. A paleoclimatic interpretation of the Eocene floras of Southeastern North America, pp. 39–59. In: GRAHAM A. (ed.) Vegetation and vegetational history of Northern Latin America. Elsevier Sci. Publ. Comp. Amsterdam-London-New York.

DUDZIAK J., ŁAPTAŚ A. 1991. Stratigraphic position of Miocene carbonate-siliclastic deposits near Chmielnik (Świętokrzyskie Mountains Area, Central Poland) based on calcareous nannofossils. Bull. Polish Acad.Sc., Earth Sc., 39(1): 55–66.

OSZAST J., 1967. Mioceńska roślinność złoża siarkowego w Piasecznie koło Tarnobrzega. Acta Palaeobot. 8(1): 1–29.

RUTKOWSKI J. 1976. Detrytyczne osady sarmatu południowego obrzeżenia Gór Świętokrzyskich. Pr. Geol. PAN, 100: 1–71

SZAFER W., 1961. Mioceńska flora ze Starych Gliwic na Śląsku. Pr.Inst.Geol. 33: 1–205.

ZASTAWNIAK E. 1980. Sarmatian leaf flora from the southern margin of the Holy Cross Mts (South Poland). Pr. Muzeum Ziemi, 33: 39–107.

STRESZCZENIE

Nowe dane o makroszczątkach roślin w środkowo-mioceńskich wapieniach w Młynach koło Chmielnika

Makroskopowe szczątki roślin w wapieniach środkowego miocenu w rejonie Chmielnika znalazł J. Rutkowski w latach sześćdziesiątych. Zebrane wówczas oraz w latach następnych materiały kopalne zostały opracowane i opublikowane przez E. Zastawniak (1980). Materiały te pochodziły z trzech odsłonięć skał wapiennych, dwóch w miejscowości Młyny (Młyny 164 i 165) oraz jednego w Stawianach. Dalsze materiały pochodzą głównie z odsłonięcia w Młynach 164 i były zbierane w latach 1978 (J. Rutkowski) i 1993 (E. Zas-

tawniak, G. Worobiec). Znajdowały się one w tej samej warstwie wapieni mikrytycznych, z której opisano wcześniej florę liściową (Zastawniak 1980).

Wiek formacji z Chmielnika, zbudowanej ze żwirów, piasków, wapieni piaszczystych i wapieni detrytycznych ustalono na górny baden – dolny sarmat (Rutkowski 1976, Alexandrowicz et al. 1982). Dudziak i Łaptaś (1991) badając kilka pojedynczych prób osadu formacji z Chmielnika uznali, że skład nannoplanktonu odpowiada zonom kokkolitowym NN5–6, czyli badenowi w schemacie stratygraficznym miocenu Paratetydy.

Nowe materiały pozwoliły uzupełnić listę florystyczną oriktocenozy o następujące taksony roślin kopalnych: Cupressaceae gen., *Alnus cecropiaefolia* (Ett.) Berger, *Platanus platanifolia* (Ett.) Knobloch, *Salix* sp. (odcisk owocu), *Crataegus* sp., *Viscum miquelii* (Geyler et Kinkelin) Czeczott, cf. *Ampelopsis* sp.

Wnioski dotyczące składu zbiorowisk kopalnych potwierdzają wcześniejsze ustalenia (Zastawniak op.cit.). Podobieństwo flory liściowej z Młynów do sarmackiej flory Starych Gliwic (Szafer 1961) oraz do flory pyłkowej osadów siarkonośnych badenianu w Piasecznie (Oszast 1967) sugeruje te same warunki klimatyczne występowania tych trzech flor kopalnych (Zastawniak op.cit.).