PALYNOLOGIC INVESTIGATIONS IN THE STRATA OF "BUDA MARL" WITH PLANT REMAINS

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Introduction

The stratum complex known by the name „Buda marl" has an important role in the Buda mountains, being a topic of several monographs. Petrologically it has been investigated by Sztrókay (1933), about its fossilized remains we have a lot of literary data, e.g.: about the *Mollusca* fauna on the basis of the investigations of Hofmann (1874) and Szörényi (1931), about its *Echinodermata* by the investigations of Pávay (1875) and Szörényi (1931), about its fossil macroflora by those of Rásky (1956, 1960, 1962, 1963).

From stratigraphic point of view it is classed by Hofmann (1871) in the lower oligocene, by Hantken (1874) and Ferenczi (1925) in the eocene. According to Szőts (1956) it represents the Lattorf storey corresponding, in his classification, to the upper eocene and lower oligocene. Vadász, on the other hand, came (1960) to the conclusion that a connection of the eocene with the lower part of oligocene was not practicable, even if the initial conditions of the formations in eocene and oligocene had been highly similar to one another. On the basis of his work quoted, published in 1957, the formation of „Buda marl" is joint with that of the so-called „bryozoic marl" and belongs to the eocene. Also E. Dudich, Jr. (1957) is regarding the strata mentioned above as a closing member of eocene.

A palynologic investigation of the „Buda marl" is motivated partly by problems of its geological age, but we can obtain some data, as well, from a palynologic point of view, concerning a problem treated of in a previous paper (Kedves, 1966b) — viz. the different character of the flora ensemble reconstructed bu macro- and microscopical plant remains.

Material and method

The research material has been made available for us by Dr. K. Rásky, we are experessing her our thankful gratitude for that. The samples have contained several vegetable macro — first of all leaf — remains. For preparing them, we have applied HCl treatment, separation with $ZnCl_2$, and HF after-treatment.

Results

The samples investigated may be regarded as comparatively rich in sporomorphs, but the condition of the single spores and particularly that of pollen particles is rather poor.

Note. — For determing the single spores and pollens, even some works not published till closing the manuscript have been used, denoted anyway by an asterisk for distinction.

Pteridophyta

Lycopsida

Lycopodiales, *Lycopodiaceae.* — *Camarozonosporites* cf. *avitrabilis* W. Kr. 1959b.

Pteropsida

Leptosporangiatae

Filicales, *Schizaeaceae.* — *Leiotriletes* cf. *wolffi* W. Kr. 1962d subfsp. *brevis* W. Kr. 1962d; Polypodiaceae — *Verrucatosporites histiopteroides* W. Kr. 1962a — the stratographic distribution of the latter species taking place in the lower — middle miocene; *Pterideae* — *Polypodiaceoisporites* cf. *microspeciosus* W. Kr. 1959b, *Undulozonosporites* fsp.

Gymnospermatophyta

Coniferophytina

Pinales, *Abietaceae, Pinoideae.* — *Pinus haploxylon* type *Pityosporites microalatus* (R. Pot. 1931b) Th. et Pf. 1953; *Pinus diploxylon* type — *Pityosporites labdacus* (R. Pot. 1931b) Th. et Pf. 1953.

Abietoideae v. *Laricoideae* — ? *Pseudotsuga,* ? *Larix* — *Inaperturopollenites* cf. *magnus* (R. Pot. 1934b) Th. et Pf. 1953.

Taxodiaceae. — * *Taxodiaceaepollenites granulatus* Kds. 1967.

Taxodiaceae v. *Cupressaceae. Inaperturopollenites dubius* (R. Pot. et Ven. 1934) Th. et Pf. 1953.

Ephedropsida

Ephedrales, *Ephedraceae, Ephedra.* — *Ephedripites (Ephedrivites)* cf. *wolkenbergensis* W. Kr. 1961a.

Angiospermatophyta

Dicotyledonopsida

Polycarpicae-Rubiales

Hamamelidales, *Platanaceae.* — *Tricolpopollenites retiformis* Pf. et Th. 1953.

Myrtales, *Nyssaceae v. Mastixiaceae.* — *Tricolporopollinites kruschi* (R. Pot. 1934b) Th. et Pf. 1953, *Tricolporopollenites* fsp. 1—2.

Terebinthales, Rutineae, ? *Meliaceae.* — *Tetracolporopollenites obscurus* Pf. et Th. 1953.

Sapindineae, *Anacardiaceae.* — *Tricolporopollenites dolium* (R. Pot. 1931) Th. et Pf. 1953; *Sapindaceae.* — *Cupanieidites ? nógrádensis* (Sics. 1959b) Sics. 1964.

Celastrales, *Icacinaceae.* — *Compositoipollenites rhizophorus* (R. Pot. 1934b) R. Pot. 1960.

Rhamnales, *Rhamnaceae.* — *Tricolporopollenites dorogensis* Kds. 1965b.

Cornales, *Araliaceae* v. *Cornaceae.* — *Tricolporopollenites* cf. *euphorii* (R. Pot. 1931a) Th. et Pf. 1953.

Rubiales, *Caprifoliaceae.* — *Tricolporopollenites microreticulatus* Pf. et Th. 1953f. *elongata* Pf. et Th. 1953.

Malvales-Solanales

Euphorbiales, *Euphorbiaceae.* — *Tricolporopollenites microdesmiaeformis* Kds. 1965b.

Rhoeadales-Asterales

Cistales, *Flacourtiaceae.* — *Tricolporopollenites pusztavámi* Kds. 1965b.

Caryophyllales-Monochlamydeae

Fagales, *Betulaceae, Betula.* — *Trivestibulopollenites betuloides* Pf. 1953a; *Ostrya* — *Triporopollenites rhenanus* Thoms. 1953.

Fagaceae. — *Tricolporopollenites pudicus* (R. Pot. 1934b) W. Kr. 1961d: *Tricolporopollenites* cf. *villensis* Thoms. 1953; *Tricolporopollenites* fsp. 1—3; *Tricolporopollenites fusus* (R. Pot. 1931a); *Tricolporopollenites oviformis* (R. Pot. 1931a); *Tricolporopollenites pusillus* (R. Pot. 1934a); *Tricolporopollenites pusillus* (R. Pot. 1934b); *Tricolporopollenites* cf. *porasper* Pf. 1953a.

Juglandales, *Juglandaceae.* — *Juglanspollenites maculosus* (R. Pot. 1931); *Plicatopollis* fsp.; *Carya* — *Caryapollenites simplex* (R. Pot. 1931b) Raatz, 1937 subfsp. *simplex* Th. et Pf. 1953; *Engelhardtia* — *Triatriopollenites* fsp.$_1$.

Myricales, *Myricaceae.* — *Triatriopollenites* fsp.$_{2-6}$.

Monocotyledonopsida

Spadiciflorae-Pandanales

Spadiciflorae, *Palmae, Chamaedorea.* — *Monocolpopollenites* fsp.$_1$; *Caryota, Livistona, Latania* v. *Chamaerops* — *Monocolpopollenites* fsp.$_2$; *Ptychosperma* v. *Geonoma* — *Monocolpopollenites* fsp.$_3$.

Cf. Araceae.

Besides sporomorphs, we have observed remains of *Hystrichospharidae* and those of chitin-skeletonned *Foraminiferae,* as well, in our material.

Discussion

The plant association reconstructed by the palynologic research method is doubtless an ensemble of remains without containing, of course, the representatives of all the plant groups that had lived together. A comparison of the families demonstrated on the basis of macro- and microfossils is giving a somewhat fuller picture about the former vegetation, as summarized below:

	Macrofossils	Microfossils
Rhodophyta	+	-
Pteridophyta		
Lycopodiaceae	-	+
Osmundaceae	+	-
Schizaeaceae	-	+
Hymenophyllaceae	+	-
Polypodiaceae	-	+
Gymnospermatophyta		
Abietaceae	-	+
Taxodiaceae	+	+
Cupressaceae	+	+?
Cephalotaxaceae	+	-
Ephedraceae	-	+
Angiospermatophyta		
Dicotyledonopsida		
Lauraceae	+	-
Platanaceae	-	+
Mimosaceae	+	-
Rhizophoraceae	+	-
Nyssaceae v. Mastixiaceae	-	+
Combretaceae	+	-
Simaroubaceae	+	-
Meliaceae	-	+?
Malpighiaceae	+	-

	Macrofossils	Microfossils
Anacardiaceae	+	+
Sapindaceae	-	+
Icacinaceae	-	+
Rhamnaceae	-	+
Araliaceae v. Cornaceae	-	+
Caprifoliaceae	+	+
Tiliaceae	+	-
Malvaceae	+	-
Sterculiaceae	+	-
Elaeocarpaceae	+	-
Euphorbiaceae	+	+
Flacourtiaceae	+	+
Passifloraceae	+	-
Actinidaceae	+	-
Proteaceae	+	-
Urticaceae	+	-
Betulaceae	+	+
Fagaceae	+	+
Juglandaceae	+	+
Myricaceae	-	+
Monocotyledonopsida		
Palmae	+	+
Cf. Araceae	-	+

The macroremains demonstrated on the basis of Rásky's investigations represent 27 families two of which belong to the Pteridophyta, three to the *Gymnospermatophyta,* and 22 to the *Angiospermatophyta,* apart from the *Rodophyta* fossils.

Our microscopic remains are referring to 24 families. (3 *Pteridophyta,* 4 *Gymnospermatophyta,* 17 *Angiospermatophyta).*

From *Pteridophyta* there is not one single corresponding family. The macrofossils belong to the *Osmundaceae* and *Hymenophyllaceae,* the microfossils to the *Lycopodiaceae, Schizaeaceae* and *Polypodiaceae* families. The absence of the macrofossils of *Schizaeaceae* is obvious as their spores are very common in the paleogeneous deposits in this country (cf. *Lygodium, Anemia).*

From the *Gymnospermatophyta,* the *Taxodiaceae* and *Cupressaceae* are equally known on the basis of the macro- and microfossils. The macrofossils of the *Abietaceae* family are not known from the Buda marl, as yet, their pollen is, however, rather frequent. These species must have lived in areas far from the seaside and their pollen, carried easily along by the wind, could be whirled by it into the sea. Also the specks of pollen of the *Ephedra* genus may have been carried by the wind into the sediment-reservoir, as this plant family of xerophilous character must have lived farther from the site of its embedding, and the vegetative organs of the plant have but a little probability of being fossilized.

From the *Angiospermatophyta,* the *Fagaceae, Juglandaceae, Flacourtiaceae,* and *Palmae,* that are staminate plants, as well the *Anacardiaceae, Euphorbiaceae,* and *Caprifoliaceae,* are represented by macro- and microfossils. Besides the relatively high number of the pollens of the *Nyssaceae* and *Myricaceae,* the absence of their macrofossils is the more obvious because the species of both families may have lived in the association of the swampy wood of the moorland. In addition to the pollens of the *Platanaceae,* ? *Meliaceae, Araliaceae* v. *Cornaceae* and cf. *Araceae,* we mention also the absence of their macro-remains.

From the *Lauraceae* family, the leaf-remains of the *Cinnamonum* family could be found. The problem of the fossilization of their pollens is generally known, they can be destroyed extremely easily. We could not find, as yet, any pollen of *Mimosaceae, Rhizophoraceae, Combretaceae, Simaroubaceae, Malpighiaceae, Tiliaceae, Malvaceae, Sterculiaceae, Elaeocarpaceae, Passifloraceae, Actinidaceae, Proteaceae* and *Urticaceae* families, in addition to their macroremains. We mention that the pollens of a great part of the families enumerated may be recognized relatively easily *(Mimosaceae, Rhizophoraceae, Tiliaceae, Elaecarpaceae, Passifloraceae),* particularly the absence of the *Tiliaceae* and *Rhizophoraceae* pollens is obvious.

The remains of the *Hystrichosphaeridae* and of the chitin-skeletonned *Foraminiferae* are referring to a maritime origin of the samples investigated.

From the point of view of stratigraphy, the following sporomorphs are of significance:

a) Those not known from the eocene in Hungary, as yet:
Leiotriletes cf. *wolffi* subfsp. *brevis*
Verrucatosporites histiopteroides
* *Taxodiaceaepollenites granulatus*
Ephedripites (Ephedripites) cf. *wolkenbergensis*
Trivestibulopollenites betuloides
Caryapollenites simplex subfsp. *simplex*
Juglanspollenites maculosus

b) The pollens occuring commonly in the tertiary period, being frequent first of all from the upper eocene;
Pityosporites microalatus f. *minor*
Pityosporites labdacus

Considering the high number of the sporomorphs from the „younger tertiary period", the samples investigated cannot be older than the oligocene.

In comparison with the spore-pollen composition recognized, so far, from the bryozic marl, we may conclude that the Buda marl must be more recent formation and thus the chronological separation of the marl formations of the Buda mountains is reasonable.

Summary

1. Palynologic investigations have been carried out on samples of the stratum of Buda marl containing plant remains. The spore-pollen investigations demonstrate the occurence of the families *Lycopodiaceae, Schizaeaceae, Polypodiaceae, Abietaceae, Taxodiaceae,* ? *Cupressaceae, Ephedraceae, Platanaceae, Nyssaceae* v. *Mastixiaceae,* ? *Meliaceae, Anacardiaceae, Sapindaceae, Icacinaceae, Rhamnaceae, Araliaceae* v. *Cornaceae, Caprifoliaceae, Euphorbiaceae, Flacourtiaceae, Betulaceae, Fagaceae, Juglandaceae, Myricaceae, Palmae* and cf. *Araceae.*

2. On the basis of the spore-pollen composition, the age of the samples investigated is oligocene.

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