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SPORES OF HUNGARIAN MIDDLE CRETACEOUS AND ITS BOTANICAL RELATIONSHIP

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Abstract

In this paper the dispersed spores obtained from the Middle Cretaceous sediments of Transdanubia are assembled in a botanical system. The highest number of species was found in the order *Schizaeales* and in the families *Gleicheniaceae* and *Lycopodiaceae*. Fewer species represent the families *Matoniaceae, Osmundaceae* and *Selaginellaceae*. Only a few bryophyte spores were observed — mostly *Hepaticopsida*.

The cosmopolitan character of many of the species demonstrates the world-wide uniform distribution of the Early Cretaceous pteridophyte flora.
Key words: Palynology, Middle Cretaceous, Transdanubian sediments, spore taxonomy, botanical relationship.

Introduction

In the last decade several papers have been published on the botanical affinity of dispersed spores of the Cretaceous. As a basis of comparison fossil in situ sporomorphs as well as spores of recent species were used. In this way with the aid of palynological data the reconstruction of the Middle Cretaceous flora was possible.

Botanical affinity, however, can be mostly established only to the family level, except those palynological works which are based on a natural system and consider possible an identification to the generic level using analogies with the spores of recent species.

Only the discovery of additional megafossilia (and of the spores and pollen they contain in situ) can be considered as a real progress in the investigation of the 100—200 million years old flora.

At present the number of „incertae sedis" spores and pollen grains is very high and the proper botanical place of the most ancient angiospermous pollen grains is nearly totally obscure.

In this paper the sporomorphs of the Hungarian Middle Cretaceous sediments are placed in a botanical system.

In Hungary the Cretaceous sediments are found in the Central Transdanubian Mountains and in the southern parts of Transdanubia. Geological monographs on there were published by FÜLÖP (1957, 1964, 1966, 1975), synthetic evaluations of the lithological formations were given by CSÁSZÁR (1976, 1978) and CSÁSZÁR and HAAS (1979).

Results

In the following a taxonomic arrangement of the microspores and miospores of the „Sporophyta" only will be attempted.

Phylum: **BRYOPHYTA**

1. Classis: **Hepaticopsida**

Genus: Triporoletes (Mtchedlishvili 1960) Playford 1971

Triporoletes radiatus (Dett, 1963) Playford 1971.
Triporoletes reticulatus (Pocock 1962) Playford 1971.
Triporoletes simplex (Cookson et Dettmann 1958) Playford 1971.

Genus: Aequitriradites (Delc. et Spr. 1955) Cookson et Dettmann 1961.

Aequitriradites spinulosus (Cookson et Dettmann 1958) Cookson et Dettmann 1961.
Aequitriradites reticulatus Kotova 1968.

Genus: Couperisporites Pocock 1962.

Couperisporites clavatoides (Deák 1964) Juhász 1980.

Genus: Coptospora Dettmann 1963.

Coptospora cf. williamsii.
Coptospora paradoxa Dettmann 1963.

2. Classis: **Anthoceropsida**

Genus: Foraminisporis W. Kr. 1959.

Foraminisporis dailyi (Cookson et Dettmann 1958) Dettmann 1963.
Foraminisporis asymmetricus (Cookson et Dettmann 1958) Dettmann 1963.

Genus: Phaeocerosporites Nagy 1968.

Phaeocerosporites purus (Deák 1964) Juhász 1980.

3. Classis: **Bryopsida**
Familia: **Sphagnaceae**

Genus: Stereisporites Th. et Pf. 1953.

Stereisporites psilatus (Ross 1949) Pf. 1953.
Stereisporites antiquasporites (Wilson et Webster 1946) Dettmann 1963.
Stereisporites aptiensis (Deák 1964) Juhász 1980.
Stereisporites grossus Takahashi 1964.
Stereisporites europeum (Bolch. 1953) Čorna 1972.

Genus: Cingutriletes (Pierce 1961) Dettmann 1963.

Cingutriletes clavus (Balme 1957) Dettmann 1963.
Cingutriletes levispeciosus (Pf. 1953) Juhász 1980.

Subclassis: **Bryidae**

Genus: Staplinisporites Pocock 1962.

Staplinisporites caminus (Balme 1957) Pocock 1962.

Genus: Coronatispora Dettmann 1963.

Coronatispora valdensis (Couper 1958) Dettmann 1963.

The occurrence of bryophyte spores in the Hungarian Middle Cretaceous can be summarized as follows (Juhász, 1980):

these spores have an inferior role in the different sporomorph-assotiations. First of all Stereisporites, Staplinisporites and Aequitriradites occur — very sporadically and in few exemplars — in the Neocomian sediments. Most of liverwort and hornwort spores are characteristic species of the Albian rocks. They occur as locally concentrated in some boreholes as indicators of coastal swamp vegetation.

Phylum: **PTERIDOPHYTA**

1. Classis: **Lycopsida**

1. Ordo: **Lycopodiales**

Genus: Retitriletes (PIERCE 1961) D. K. M. S. 1963.
Retitriletes tenuis (BALME 1957) JUHÁSZ 1975.
Retitriletes austroclavatidites (COOKSON 1953) D. K. M. S. 1963.
Retitriletes clavatoides (COUPER 1958) D. K. M. S. 1963.
Retitriletes glebulentus (KEMP 1970) JUHÁSZ 1975.
Retitriletes dentimuratus (BRENNER 1963) JUHÁSZ 1975.

Genus: Vadaszisporites (DEÁK et COMBAZ 1967) JUHÁSZ 1975.
Vadaszisporites urkuticus (DEÁK 1964) DEÁK et COMBAZ 1967.
Vadaszisporites pseudofoveolatus (DEÁK 1964) DEÁK et COMBAZ 1967.
Vadaszisporites uniformis (SINGH 1964) JUHÁSZ 1975.
Vadaszisporites gregussi JUHÁSZ 1975.
Vadaszisporites minutireticulatus JUHÁSZ 1975.
Vadaszisporites sacali DEÁK et COMBAZ 1967.
Genus: Foveosporites BALME 1957.
Foveosporites canalis BALME 1957.
Foveosporites subtriangularis (BRENNER 1963) SCHULZ 1966.
Genus: Sestrosporites DETTMANN 1963.
Sestrosporites pseudoalveolatus (COUPER 1958) DETTMANN 1963.
Genus: Camarozonosporites (PANT ex R. POT. 1956) KLAUS 1960.
Camarozonosporites cerniidites (ROSS 1949) W. KR. 1959.
Camarozonosporites insignis NORRIS 1967.
Camarozonosporites concinnus S. K. SRIVASTAVA 1972.
Camarozonosporites Hammenii VAN AMEROM 1965

Of the Lycopodiaceae spores representants of the foveolate Foveosporites, Sestrosporites and the slightly reticulate Retitriletes are characteristic species mostly of the Neocomian sediments. Vadaszisporites and Camarozonosporites species are frequent in Albian (JUHÁSZ, 1975).

2. Ordo: **Selaginellales**

Genus: Echinatisporis W. KR. 1959.
Echinatisporis varispinosus (POCOCK 1962) S. K. SRIVASTAVA 1975.
Echinatisporis levidensis (Balme 1957) S. K. SRIVASTAVA 1972.
Genus: Cepulina MALJAVKINA 1949 ex SCHULZ 1967.
Cepulina truncata (COOKSON 1953) SCHULZ 1967.
Genus: Ceratosporites COOKSON et DETTMANN 1958.
Ceratosporites equalis COOKSON et DETTMANN 1958.
Ceratosporites rarus DÖRING 1965.
Genus: Heliosporites (SCHULZ 1962) S. K. SRIVASTAVA 1972.
Heliosporites kemensis (CHLONOVA 1960) S. K. SRIVASTAVA 1972.
Genus: Densoisporites WEYLAND et KRIEGER 1953.
Densoisporites microrugulatus BRENNER 1963.
Densoisporites velatus WEYLAND et KRIEGER 1953.

These species occur sporadically in Hungarian Middle Cretaceous; stratigraphically they are insignificant.

2. Classis: **Pteropsida**

1. Subclassis: **Osmundidae**

Ordo: **Osmundales**

Genus: Osmundacidites COUPER 1953.
Osmundacidites wellmanii COUPER 1953.
Osmundacidites densiornamentata (KLIMKO 1961) JUHÁSZ 1979.
Genus: Baculatisporites TH. et PF. 1953.
Baculatisporites comaumensis (COOKSON 1953) R. POT. 1956.
Baculatisporites kolpachevensis (KLIMKO 1961) JUHÁSZ 1979.
Baculatisporites brevibaculatus (DÖRING 1965) JUHÁSZ 1979.
Genus: Conbaculatisporites KLAUS 1960.
Conbaculatisporites cretaceus DEÁK 1964.
Genus: Todisporites COUPER 1958.
Todisporites major COUPER 1958.
Todisporites minor COUPER 1958.

Among the spores of this fern family, Todisporites, Osmundacidites, Baculatisporites species are frequent also in Jurassic. The *Conbaculatisporites cretaceus* DEÁK is characteristic in Middle Albian of Hungary.

2. Subclassis: **Polypodiide**

1. Ordo: **Schizaeales**

1. Familia: **Klukiaceae**

Genus: Ischyosporites BALME 1957.
Ischyosporites estherae DEÁK 1964.
Ischyosporites baconicus JUHÁSZ 1979b
Genus: Klukisporites COUPER 1958.
Klukisporites scaberis (COOKSON et DETTMANN 1958) DETTMANN 1963.
Klukisporites lacunus FILATOFF 1975.
Genus: Foveasporis (W. KR. 1959b) JUHÁSZ 1979b
Foveasporis agathoecus (R. POT. 1934) W. KR. 1959b
Foveasporis budejovicensis (PACLTOVÁ 1961) JUHÁSZ 1979b
Genus: Fueloepisporites JUHÁSZ 1979b
Fueloepisporites hungaricus JUHÁSZ 1979b
Fueloepisporites crassus JUHÁSZ 1979b
Fueloepisporites vokanyensis JUHÁSZ 1979b
Fueloepisporites foveasolidus (W. KR. 1967) JUHÁSZ 1979b
Fueloepisporites asolidus (W. KR. 1959b) JUHÁSZ 1979b

Detailed nomenclatural and stratigraphical elaboration of *Klukiaceae* spores is published in an earlier paper (JUHÁSZ, 1979b). Klukisporites contains some transitional species from Jurassic, most of Fueloepisporites species lived in the Neocomian; the two Ischyosporites species are common in Albian, Foveasporis is frequent in Cenomanian and Upper Cretaceous sediments.

2. Familia: **Lygodiaceae**

Genus: Concavissimisporites (DELC. et SPR. 1955) DELCOURT, DETTMANN et HUGHES 1963.
Concavissimisporites gibberulus (BOLCH. 1956) BOLCH. 1968.
Concavissimisporites verrucosus (DELC. et SPR. 1955) DELCOURT, DETTMANN et HUGHES 1963.
Concavissimisporties variverrucatus (COUPER 1958) BRENNER 1963
Concavissimisporites reticulatus (MALJAVKINA 1949) JUHÁSZ 1979.

Genus: Impardecispora VENKATACHALA, KAR et RAZA 1969.
Impardecispora apiverrucata (COUPER 1958) VENKATACHALA, KAR et RAZA 1969.
Impardecispora trioreticulosa (COOKSON et DETTMANN 1958) VENKATACHALA, KAR et RAZA 1969.
Impardecispora marylandensis (BRENNER 1963) S. K. SRIVASTAVA 1975.
Impardecispora minuta (BOLCH. 1961) JUHÁSZ 1979.

Genus: Pilosisporites DELCOURT et SPRUMONT 1955.
Pilosisporites notensis COOKSON et DETTMANN 1958.

Genus: Trilites (ERDTMAN 1947, COOKSON 1947) ex COUPER 1953.
Trilites triangulus KEDVES 1964.
Trilites knaueri JUHÁSZ 1972.
Trilites harskutensis JUHÁSZ 1972.

Genus: Pereisporites (JUHÁSZ 1972) S. K. SRIVASTAVA 1975.
Pereisporites minor (JUHÁSZ 1972) S. K. SRIVASTAVA 1975.
Pereisporites kyrtomiformis (JUHÁSZ 1972) JUHÁSZ 1979.

Genus: Bikolisporites (JUHÁSZ 1972) S. K. SRIVASTAVA 1975.
Bikolisporites toratus (WEYLAND et GREIFELD 1953) S. K. SRIVASTAVA 1975.
Bikolisporites baconicus (JUHÁSZ 1972) JUHÁSZ 1977c.
Bikolisporites distalrugulatus (JUHÁSZ 1972) JUHÁSZ 1977c.
Bikolisporites transdanubicus (JUHÁSZ 1972) JUHÁSZ 1977c.

Genus: Acritosporites (OBONIZKAJA 1964) JUHÁSZ 1979b
Acritosporites sibiricus (BOLCH. 1961) OBONIZKAJA 1964.
Acritosporites kyrtomus JUHÁSZ 1979b.
Acritosporites transdanubicus JUHÁSZ 1979b.
Acritosporites triangularis (DEÁK 1964) JUHÁSZ 1979b.
Acritosporites sibiricus (BOLCH. 1961) OBONIZKAJA 1964 *forma minor* JUHÁSZ 1979b.
Acritosporites rasellus (ALEKSANDROVA 1962) JUHÁSZ 1979b.
Acritosporites excavatus (BRENNER 1963) JUHÁSZ 1979b.

The above-mentioned *Lygodiaceae* species and their nomenclature are discussed in several papers: BOLCHOVITINA (1968), VENKATACHALA, KAR and RAZA (1969), MARKOVA (1966), JUHÁSZ (1972, 1977c, 1979b), S. K. SRIVASTAVA (1975).

In the Early Neocomian first Pilosisporites and Concavissimisporites species appeared, in Barremian the spores of Trilites and Bikolisporites. In Middle Albian the Impardecispora, while in Upper Albian-Lower Cenomanian the Acritosporites are frequent.

3.—4. Familia: **Acrostichopteridaceae — Mohriaceae**

Genus: Cicatricosisporites R. POT. et GELL. 1933.
Cicatricosisporites venustus DEÁK 1964.
C. minutaestriatus (BOLCH. 1961) POCOCK 1965.
Cicatricosisporites augustus C. SINGH 1971.
C. proxiradiatus KEMP 1970.
C. minor (BOLCH. 1961) POCOCK 1965.
C. mediostriatus (BOLCH. 1961) POCOCK 1965.
C. coconinoensis AGASIE 1969.
C. pacificus (BOLCH. 1961) JUHÁSZ 1977c.
C. potomacensis BRENNER 1963.
C. baconicus DEÁK 1964.
C. pseudotripartitus (BOLCH. 1961) DETTMANN 1963.
C. hughesi DETTMANN 1963.

Genus: Nodosisporites DEÁK 1964.
Nodosisporites verrucosus DEÁK 1964.
Nodosisporites costatus DEÁK 1964.

5. Familia: **Anemiaceae**

Genus: Plicatella MALJAVKINA 1949.
Plicatella trichacantha MALJ. 1949.
Genus: Appendicisporites WEYLAND et KRIEGER 1953.
Appendicisporites bifurcatus C. SINGH 1964.
App. crimensis (BOLCH. 1961) POCOCK 1965.
App. pseudomacrorhyzus (BOLCH. 1961) JUHÁSZ 1979.
App. potomacensis BRENNER 1963.
App. tricornitatus WEYLAND et KRIEGER 1953.
App. tricuspidatus WEYLAND et GREIFELD 1953.
App. stylosus (THG. 1949) DEÁK 1964.
App. erdtmani POCOCK 1965.
App. dentimarginatus BRENNER 1963.
App. unicus (MARKOVA 1961) C. SINGH 1964
Appendicisporites concentricus KEMP 1970.
App. cristatus (MARKOVA 1961) JUHÁSZ 1979.
Genus: Costatoperforosporites DEÁK 1962.
Costatoperforosporites fistulosus DEÁK 1962.
Costatoperforosporites triangulatus DEÁK 1962.
Costatoperforosporites foveolatus DEÁK 1962.

REED (1947) placed into this family the fossil Protornithopteris and the recent Ornithopteris, Hemianemia and Anemia species. In the palynological literature opinions differ on the question of priority between Plicatella MALJ. and Appendicisporites WEYLAND et KRIEGER. The author chares the opinion of those who accept the validity of both genera. So the triangular, on the corners strongly thickened forms without appendages are placed in Plicatella, while those with appendages in the Appendicisporites formgenera.

6. Familia: **Schizaeaceae**

Genus: Corniculatisporites KUVAEVA 1972.
Corniculatisporites virgatus (DEÁK 1963) KUVAEVA 1972.
Corniculatisporites alekhinii (BOLCH. 1953) KUVAEVA 1972.
Corniculatisporites tudariensis KUVAEVA 1972.
Corniculatisporites magniolobatus (BOLCH. 1953) KUVAEVA 1972.
Corniculatisporites bolchovitinae KUVAEVA 1972.
Corniculatisporites auritus (SINGH 1971) JUHÁSZ 1977b.
Corniculatisporites nemanicensis (PACLTOVÁ 1961) JUHÁSZ 1977b.
Genus: Cicatricososporites (TH. et PF. 1953) W. KR. 1959.
Cicatricososporites phaseolus (DELC. et SPR. 1955) W. KR. 1959.
Genus: Verrucatosporites (TH. et PF. 1953) W. KR. 1959.
Verrucatosporites contractus (BOLCH. 1953) W. KR. 1959.
Genus: Microfoveolatosporis (W. KR. 1959) R. POT. 1966.
Microfoveolatosporis baconicus JUHÁSZ 1977b.
Microfoveolatosporis surensis JUHÁSZ 1977b.
Microfoveolatosporis gallicus (DEÁK et COMBAZ 1967) JUHÁSZ 1977b.
Microfoveolatosporis csaszari JUHÁSZ 1977b.

In the system of REED (1947) which in the case of *Schizaeales* is adopted here, the recent schizaeoid species with monolete spores (Schizaea, Microschizaea, Actinostachys) were placed into the family *Schizaeaceae* sensu stricto. The spores in these recent genera have striate, verrucate-tuberculate, foveolate-microfoveolate ornamentation. Their fossil equivalents were discovered among the spores of the Albian sediments.

2. Ordo: **Filicales**

The Middle Cretaceous fern-spores show botanical relationship with the following families: **Gleicheniaceae, Matoniaceae, Hymenophyllaceae, Dicksoniaceae -Cyatheaceae.**

1. Familia: **Gleicheniaceae**

Genus: Gleicheniidites (Ross 1949) Bolchovitina 1966.

Gleicheniidites senonicus (Ross 1949) Bolch. 1968.
Gleicheniidites umbonatus Bolch. 1953) Bolch. 1968.
Gleicheniidites radiatus (Bolch. 1953) Bolch. 1968
Gleicheniidites rasilis (Bolch. 1953) Bolch. 1968.
Gleicheniidites compositus (Bolch. 1953) Deák 1964.
Gleicheniidites laetus (Bolch. 1953) Bolch. 1968.
Gleicheniidites carinatus (Bolch. 1953) Bolch. 1968.
Gleicheniidites saparicus Juhász 1977a.

Genus: Plicifera Bolchovitina 1966.

Plicifera decora (Chlonova 1960) Bolch. 1968.
Plicifera delicata (Bolch. 1953) Bolch. 1966.

Genus: Ornamentifera Bolchovitina 1966.

Ornamentifera tuberculata (Grigorjeva 1961) Bolch. 1968.
Ornamentifera granulata (Grigorjeva 1961) Bolch. 1968.
Ornamentifera peregrina (Bolch. 1953) Bolch. 1968.

Genus: Clavifera Bolchovitina 1966.

Clavifera nigra (Bolch. 1953) Juhász 1977a.
Clavifera triplex (Bolch. 1953) Bolch. 1966.
Clavifera rudis Bolch. 1968.
Clavifera tuberosa Bolch. 1968.

The systematics of the fossil trilete, tricrassate *Gleicheniaceae* was first discussed by Krutzsch (1959) who established six subformgenera inside *Gleicheniidites*.

Bolchovitina (1966, 1968) compared the recent *Gleicheniaceae* spores with the Cretaceous „*gleicheniid*" forms and establishing four new formgenera proved the relationship, too. The author followed her system in the investigation of the Hungarian Middle Cretaceous *Gleicheniaceae* (Juhász, 1977a).

2. Familia: **Matoniaceae**

Genus: Matonisporites (Couper 1958) Dettman 1963

Matonisporites major Deák 1964.
Matonisporites simplex Deák 1964.
Matonisporites minor Deák 1964.
Matonisporites weylandi (Döring 1965) Juhász 1979a.

Genus: Phlebopterisporites Juhász 1979a.

Phlebopterisporites hungaricus Juhász 1979a.
Phlebopterisporites harskutensis Juhász 1979a.
Phlebopterisporites equiexinus (Couper 1958) Juhász 1979a.
Phlebopterisporites globosus (Kimyai 1966) Juhász 1979a.

Genus: Phanerosorisporites Juhász 1979a.

Phanerosorisporites surensis Juhász 1979a.
Phanerosorisporites pectinataeformis (Dettmann 1963) Juhász 1979a.

Genus: Trilobosporites Pant ex Pot. 1956.

Trilobosporites goczani Juhász 1979a.

The family *Matoniaceae*, recently having only 3 species, was a significant element of the Early Cretaceous flora, especially in marshy areas under humid and hot climate (JUHÁSZ 1979a).

3.—5. Familia: **Cyatheaceae-Dicksoniaceae-Hymenophyllaceae**

Genus: Cyathidites COUPER 1953.
Cyathidites australis COUPER 1953.
Cyathidites minor COUPER 1953.
Cyathidites rarus (BOLCH. 1953) DEÁK 1964.
Genus: Dictyophyllidites COUPER 1958.
Dictyophyllidites harrisii COUPER 1958.

The system and botanical relationship of the laevigate trilete spores is unsolved. Only a few forms can be located into the taxonomical system.

3. Classis: **Sphenopsida**

Genus: Calamospora SCHOPF 1944.
Calamospora mesozoica COUPER 1958.

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Genus: Deltoidospora MINER (1935) R. POT. 1956.
Deltoidospora diaphana (WILSON et WEBSTER 1946) JUHÁSZ 1979.
Deltoidospora ordinata (BRELIE 1964) JUHÁSZ 1979.
Deltoidospora juncta (KARA-MURZA 1954) C. SINGH 1964.
Genus: Undulatisporites PFLUG 1953.
Undulatisporites pannuceus (BRENNER 1963) C. SINGH 1971.
Undulatisporites undulapolus BRENNER 1963.
Undulatisporites sculpturoides PF. 1953.
Genus: Obtusisporis (W. KR. 1959) POCOCK 1970.
Obtusisporis jurienensis (BALME 1957) JUHÁSZ 1979.
Obtusisporis mesozoicus KDS et SCSICS 1964.
Genus: Varirugosisporites DÖRING 1965.
Varirugosisporites lentiformis DÖRING 1965.
Varirugosisporites proxigranulatus (BRENNER 1963) JUHÁSZ 1979.
Varirugosisporites pseudogibberulus (BOLCH. 1961) JUHÁSZ 1979.
Varirugosisporites verrucosus (DEÁK 1964) JUHÁSZ 1979.
Genus: Gemmatriletes VAN DER HAMMEN 1954.
Gemmatriletes irregularis (BRENNER 1963) JUHÁSZ 1979.
Genus: Leptolepidites (COUPER 1953) NORRIS 1969.
Leptolepidites verrucatus COUPER 1958.
Leptolepidites psarorus NORRIS 1969.
Genus: Rubinella MALJAVKINA 1953.
Rubinella major (COUPER 1958) NORRIS 1969.
Genus: Clavatisporites KDS et SCICS 1964.
Clavatisporites rotundiformis (KRASNOVA 1961) JUHÁSZ 1979.
Genus: Rotverrusporites DÖRING 1965.
Rotverrusporites brevilaesuratus (POCOCK 1962) DÖRING 1965.
Genus: Duplexisporites DEÁK 1962.
Duplexisporites generalis DEÁK 1962.
Genus: Vinculisporites DEÁK 1964.
Vinculisporites flexus DEÁK 1964.
Genus: Distaltriangulisporites C. SINGH 1971.
Distaltriangulisporites perplexus (C. SINGH 1964) C. SINGH 1971.

Genus: Asbeckiasporites VON BRELIE 1964.
Asbeckiasporites wirthii BRELIE 1964.
Genus: Antulsporites ARCHANGELSKY et GAMERRO 1966.
Antulsporites distaverrucosus (BRENNER 1963) ARCHANGELSKY et GAMERRO 1966.
Genus: Trubasporites VAVRDOVA 1964.
Trubasporites foveolatus (COUPER 1958) VAVRDOVA 1964.
Genus: Collarisporites DEÁK 1964.
Collarisporites fuscus DEÁK 1964.
Genus: Laevigatosporites (IBRAHIM 1933) R. POT. et KREMP 1954.
Laevigatosporites ovatus WILSON et WEBSTER 1946.

Conclusions

The above taxonomical list shows the presumable botanical relationship of the spores discovered and identified in the Transdanubian Middle Cretaceous sediments.

It gives a qualitative picture about the plant groups which lived on the lands bordering the assemblages. It can be established:

1) In the Middle Cretaceous the spores of ferns show higher number of species than of pollen gymnosperms and angiosperms;

2) the most variable and rich in species in the order *Schizaeales*, which dominated at this time on the whole hemisphere;

3) inside the order *Schizaeales* a sequence of evolution can be observed: the most ancient is the family *Klukiaceae*, the *Anemiaceae* culminated typically in Lower Cretaceous, the most longevous is the *Mohriaceae-Acrostichopteridaceae* (its spores are frequent in Tertiary, too) the youngest is the Schizaeaceae with monolete spores evolved in the Albian;

4) the *Gleicheniaceae* and *Matoniaceae* are very important components of the Middle Cretaceous. The family *Gleicheniaceae* occurs all-over the world, on some places (Russian Platform, Crimea) it is dominating in the Aptian and Albian. The family *Matoniaceae* is more bound to given environmental-climatic conditions and so is a locally accumulating component;

5) besides *Filicales* the representatives of *Lycopodiaceae* are significant. In the Transdanubian assemblages *Retitriletes* and *Foveosporites* in the Neocomian, *Vadaszisporites* and *Camarozonosporites* species in the Albian are frequent;

6) although laevigate spores are frequent, due to their unsolved botanical affinities no opinion can be formed about the role of families *Cyatheaceae, Dicksoniaceae, Hymenophyllaceae* and *Cheiropleuriaceae* in the Cretaceous — at present they are significant in the tropical fern-flora;

7) the *Bryophyta* spores are insignificant in the Hungarian Early Cretaceous; the spores of the *Hepaticopsida* occur in greater number;

8) among the studied *Bryophyta* and *Pteridophyta* spores relatively few are endemic, the majority of the spores occur in the North American, Asian, some of them in the Australian Early Cretaceous sediments, too. That leads us to believe that before the explosion-like radiation of the angiosperms in the Upper Cretaceous, in the Lower and Middle Cretaceous a more or less homogenous flora with many cosmopolitan species on the land;

9) from the recent *Pteridophyta* families the *Gleicheniaceae, Matoniaceae, Anemiaceae, Schizaeaceae* and even the majority of *Lycopodiaceae* live on tropical-subtropical areas, the number of species is not very high, the ecological limits are some-

times narrow. Their occurrence in the Cretaceous all over the world suggests that the representatives of these families in those times had a great ecological and they showed much higher adaptability than the recent species do.

References

BRENNER, G. J. (1963): The spores and pollen of the Potomac Group of Maryland.—Bull. Md. Dept Geol., *27*, 1—225.

ČORNA, O. (1968): Some spores and pollen from Aptian-Albian of West Carpathians.—Geol. Sb. Geol. Carp., *19*, 225—254.

COUPER, R. A. (1958): British Mesozoic microspores and pollen grains.—Palaeontographica B., *103*, 75—179.

CSÁSZÁR, G. (1976): The Middle Cretaceous in Hungary.—Ann. Mus. Hist. Nat. Nice., *4*, XI. 1—14.

CSÁSZÁR, G. (1978): The Tés Clay Formation: a sketch of facies evolution.—Bull. Hung., Geol. Soc., *108*, 328—342.

CSÁSZÁR, G. and HAAS, J. (1979): Review of the Facies and Palaeogeography of the Cretaceous in Hungary.—Aspekte der Kreide Europas, IUGS ser. A., *6*, 413—424.

DEÁK, M. (1964): Contribution á l'etude palynologique de groupe d'argiles a Munieria de l'etage Aptien.—Acta Botan. Ac. Sci. Hung., *10*, 95—126.

DETTMANN, M. E. (1963): Upper Mesozoic microfloras southeastern Australia.—Proc. Roy. Soc. Vict. *77*, 1—148.

DÖRING, H. (1965): Die Sporenpalaeontologische Gliederung des Wealden in Westmecklenburg.—Geologie, *47*, 1—117.

FÜLÖP, J. (1958): Die kretazeischen Bildungen des Gerecse-Gebirges.—Geol. Hung., ser. Geol.. *11*, 1—124.

FÜLÖP, J. (1964): Unterkreide-Bildungen (Berrias-Apt) des Bakony-Gebirges.—Geol. Hung., ser. Geol *13*, 1—194.

FÜLÖP, J. (1966): Les formations Crétacées de la Montagne de Villány.—Geol. Hung., ser. Geol. *15*, 1—131.

FÜLÖP, J. (1975): The Mesozoic basement horst blocks of Tata.—Geol. Hung., ser. Geol., *16*, 1—122.

JUHÁSZ, M. (1972): Study of the *Trilites* formgenus in Lower Cretaceous deposits.—Acta Biol. Szeged, *18*, 43—53.

JUHÁSZ, M. (1975): *Lycopodiaceae* spores from Lower Cretaceous deposits of Hungary.—Acta Biol. Szeged, *21*, 21—34.

JUHÁSZ, M. (1977a): *Gleicheniaceae* spores from Lower Cretaceous deposits of Hungary.—Acta Biol. Szeged, *23*, 3—17.

JUHÁSZ, M. (1977b): Monolete spores of *Schizaeaceae* from Hungarian Albian sediments.—Acta Biol. Szeged. *23*, 19—38.

JUHÁSZ, M. (1977c): Die Blütezeit von Schizaeales: die Unterkreide.—Botan. Közlem., *64*, 31—34.

JUHÁSZ, M. (1979a): Dispersed *Matoniaceae* spores from the Hungarian Lower and Middle Cretaceous sediments.—Acta Biol. Szeged., *25*, 33—47.

JUHÁSZ, M. (1979b): Investigation of some genera from the Lower and Middle Cretaceous in Transdanubia.—Acta Biol. Szeged., *25*, 49—64.

JUHÁSZ, M. (1979): Palynology of Hungarian Lower and Middle Cretaceous.—Diss. Cand. Sci. Szeged, 1—123. (In Hungarian)

JUHÁSZ, M. (1980): Bryophyte spores from Hungarian Early Cretaceous rocks.—Acta Biol. Szeged., *26*, 51—62.

KRUTZSCH, W. (1959G Mikropaläontologische (sporenpaläontologische) Untersuchungen in der Braunkohle des Geiseltales.—Geologie, *8*, 1—435.

NORRIS, G. (1967): Spores and pollen from the Lower Colorado Group (Albian? Cenomanian) of central Alberta.—Palaeontographica B, *120*, 75—112.

REED, C. F. (1947): The phylogeny and ontogeny of the *Pteropsida*. I. Schizaeales.—Bol. Soc. Brot. *21*, 71—197.

SRIVASTAVA, S. K. (1975): Microspores from the Fredericksburg Group (Albian) of the Southern United States.—Paléobiol. Cont. *6*, 1—119.

VENKATACHALA, B. S., KAR, R. K. and RAZA, S. (1968): Morphological study and revision of the spore genus *Trilobosporites* Pant ex R. Pot. 1956. — Palaeobotanist, *17*, 123—127.

Болховитина, Н. А. (1953): Спорово-пыльцевая характеристика меловых отложений центральных областей СССР. — Труды ГИН АН СССР, *145*, 1—183.

— (1961): Ископаемые и современные споры семейства схизейных. — Труды ГИН АН СССР, 40, 1—165.

— (1968a): Споры глейхениевых папоротников и их стратиграфическое значение. — Труды ГИН АН СССР, *186*, 1—116.
— (1968б): Систематика и стратиграфическое значение спор глейхениевых и схизейных. ГИН АН СССР, *128*, 1—52.
Маркова, Л. Г. (1966): Распостранение спор семейства схизейных в меловых отложениях Западно-Сибирской низменности и их значение для стратиграфии. — Мат. ко 2-ой Межд. Палинол. Конф., 214—235.
Обоницкая, Е. К. (1964): Споры нового формального рода Acritosporites из верхнемеловых отложениях Центральных Кызылкумов и Южного Приаралья. — Палеонт. Ж., *2*, 121—124.

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