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THE SIGNIFICATION OF THE PALEOCENE MICROFLORA FROM JIBOU (SĂLAJ DISTRICT) FOR THE PALEOGENE PALINOLOGICAL HERITAGE OF ROMANIA

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Abstract. From the Late Thanetian from Jibou-Sălaj (NW Romania), the richest Paleocene microflora from Romania is mentioned (Tab. 1). The main significations on systematics, biostratigraphy, paleoclimate and paleoenvironment are pointed out.

Keywords: Late Thanetian, microflora, NW Romania.

INTRODUCTION

The lacustrine deposits related to Rona Member – component of the Jibou Formation (Late Maastrichtian-Lutetian)- were the subject of several researches recently carried on paleontology and stratigraphy. Due to some new exposures appeared as a consequence of the works related to the Jibou Botanical Garden aggrandizement a revision of the Rona Member was recently done by Codrea & Săsăran (2002).

The swamp tendencies episodes occurred during the lake evolution, allowed an exceptional fossilization for Paleocene flora and fauna. Gheerbrant et al. (1999) studied the vertebrate assemblages. In his doctoral thesis, Baciu (2003) described the charophytes collected from the same deposits. His list of taxa evidences an extremely interesting assemblage including *Dughiella bacillaris* and *Nitellopsis (C.) paracolensis*. Both prove that the lower part of the Rona Member belongs to Thanetian.

Petrescu (2003), Petrescu & Codrea (2003) and Codrea et al. (2003) pointed out the importance of the pollinic assemblage evidenced in the Upper Paleocene outcrop from the Botanical Garden from Jibou. From the same outcrop (known as JBB 4), originate the richest vertebrate assemblage ever found in the Rona Member (Codrea et al., 2003).

THE REPERTORY OF THE PALEOCENE MICROFLORA FROM JIBOU

Codrea et al. (2003, p. 107) made a first approach on the Upper Paleocene pallinology from Jibou. The authors affirm that "the studied microflora remains the most representative for the Late Paleocene from our country; it includes several new taxa completely new for Romania".

Petrescu (2003; p. 27) published in a recent synthesis focused on the Cenozoic pallinology from Romania more than hundred taxa originating from the same already mentioned outcrop.

Some interpretations on the lacustrine paleonvironment where this microflora succeed to preserve in excellent shape, as well as several data concerning the Upper Paleocene paleoclimate belong to Petrescu & Codrea (2003).

a. The **systematic** study carried on 30 samples pointed out a large palinomorph diversity, including more than 125 forms (Tab. 1).

The PHITOPLANKTON (not included in the percents calculated for the various vegetal groups) is dominating in some samples, represented by *Ovoidites, Botryococcus* and *Pediastrum*.

The SPORES (over 30 % in some samples) are very diverse. More than 25% belongs to various Ferns. Concerning their frequency, we observed the following:

very frequent: *Leiotriletes microadriennis* KRUTZSCH, 1959*, Laevigatisporites haardti* (POTONIÉ & VENITZ, 1934) THOMSON & PFLUG, 1953;

frequent: *Triplanosporites microsinuosus* PFLANZEL 1955*, Polypodiaceoisporites marxheimensis* (MÜRRIGER & PFLUG, 1913) KRUTZSCH, 1953;

large part of the spores are however, rare: *Leiotriletes wolffi* KRUTZSCH, 1962*, L. microlepioidites* KRUTZSCH, 1962*, L. paramaximus* KRUTZSCH, 1959*, L. maxoides* KRUTZSCH, 1962 *palaeogenicus* KEDVES, 1973*, Triplanosporites sinuosus* KRUTZSCH, 1962*, Laevigatisporites gracilis* WILSON & WEBSTER, 1946*, L. rochei* CAVAGNETTO, 1967*, L. discordatus* PFLUG 1953*, L. adiscordatus* KRUTZSCH 1959*, Polypodiidites secundus* (POTONIE 1934) KRUTZSCH 1963*, Microfoveolatosporis pseudodentatus* KRUTZSCH 1959 etc.

Also diverse are the spores with sporadic distribution: *Baculatisporites primarius crassiprimarius* KRUTZSCH 1967*, Toroiosporis (D.) solutionis* KRUTZSCH 1959*, T (T.) aneddeni* KRUTZSCH 1959*, Triplanosporites sinomaxoides* KRUTZSCH 1962*, Intrapunctisporis gracilioides* KRUTZSCH & VANHOORNE 1977*, Verrucatosporites favus* (POTONIE 1931) THOMSON & PFLUG 1953*, Camarazonosporites (C.) heskemensis* (PFLANZL 1955) KRUTZSCH 1959*, Ornatisporis belgicus* KRUTZSCH & VANHOORNE 1977 etc.

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A complete list – for the actual grade of knowledge- of the Ferns spores originating from the upper Thanetian from Jibou is given in Tab. 1.

The spores belonging to Sphagnaceae are not exceeding 5%, but they are diverse. The most frequent is *Stereisporites (St.) stereoides* (POTONIÉ & VENITZ 1934) THOMSON & PFLUG 1953. Generally, the Sphagnaceae trilete spores are rare (*St. eovalidus* KRUTZSCH & VANHOORNE 1977*, St. involutus* (DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH 1963 etc.).

The GYMNOSPERMS have a poor distribution into the pollen spectrum (less than 2%).

The pollen of CONIFERALS is represented by the bisaccate pollen belonging to *Pityosporites microalatus* (POTONIÉ 1931) THOMSON & PFLUG1953 and *P. labdacus* (POTONIÉ 1931) THOMSON & PFLUG 1953, as well as to *Piceapollis* cf. *tobolicus* (PANOVA 1966) KRUTZSCH 1971 (occurring sporadic or rare). Also sporadic, we remarked *Inaperturopollenites* cf. *dubius* (POTONIÉ 1931) THOMSON & PFLUG 1953.

The Ephedraceae pollen appears sporadic only, with clear evidence of *Ephedripites (D.) fusiformis* (SCHAKMUNDES 1965) KRUTZSCH 1976.

Sporadic, one can observe forms of *Cycadopites* [*C.* cf. *cycadioides* (ZAKLINSKYA 1957) KEDVES 1968]. They could originate from primitive Gymnospermous.

By far, the ANGIOSPERMS are dominating the pollen spectrum, in the majority of the samples, both in abundance and diversity.

The MONOCOTYLEDONOUS can reach to 8-10% into the spectrum. They belong to two morphologic groups: monoporate pollen related to *Sparganiaceaepollenites* (about 3 %) and diverse Palm pollen, related to *Monocolpopollenites*, *Arecipites and Dicolpopollis*.

The fossil pollen of *Proxapertites* (related with the recent pollen of Arceae) appears rare to relatively frequent in the coal levels.

Sporadic appears monoporate *Graminidites* sp.pollen.

The DICOTYLEDONOUS (55-60%) revealed a large diverse morphology. Some of them are unique for the lower Cenozoic deposits from Romania. Others are very frequent or frequent: *Interpollis supplingensis* (PFLUG 1953) KRUTZSCH 1961*, Plicapollis pseudoexcelsus* (KRUTZSCH 1958) KRUTZSCH 1960, *Triatripollenites coryphaeus coryphaeus* (POTONIÉ 1931) THOMSON & PFLUG 1953*, T. rurensis* PFLUG & THOMSON 1953*, Subtriporopollenites constans* PFLUG 1953*, S. anulatus* THOMSON & PFLUG 1953*, Compositoipollenites rizophorus* POTONIÉ 1960*, Tricolpopollenites liblarensis* (THOMSON 1950) THOMSON & PFLUG 1953*, Tricolporopollenites cingulum* (POTONIÉ 1931) THOMSON & PFLUG 1953 etc.

The greatest part of the Dicotyledonous is rare or sporadic, as it can be observed in Tab. 1.

A lot of the Jibou Dicotyledonous are new for the Romania: *Nudopollis endangulatus* PFLUG 1953*, N. terminalis* (THOMSON & PFLUG 1953) PFLUG 1953*, Anacolsidites pseudoefllatus* KRUTZSCH 1959*, Plicatopollis lunatus* KEDVES 1974*, Platycaryapollenites levis* (POTONIÉ 1931) KRUTZSCH 1969*, Caryapollenites praesimplex* KRUTZSCH & VANHOORNE 1977*, Subtriporopollenites magnoporatus* (THOMSON & PFLUG 1953) KRUTZSCH 1960*, S. subporatus* KRUTZSCH 1960*, S. intrastructurus* KRUTZSCH & VANHOORNE 1977*, Bombacidites kettingensis* (PFLUG 1953) KRUTZSCH 1960*, Tricolporopollenites pseudoiliacus* KRUTZSCH & VANHOORNE 1977 etc.

Some pollen forms of Palmae are also new for the Paleogene microflora from Romania, like *Monocolpopollenites magnus* KEDVES 1961.

Proxapertites operculatus VAN DER HAMMEN 1956 is equally mentioned for the first time in Romanian tertiary deposits.

In the same category one can mention several spores from Jibou: *Laevigatisporites rochei* CAVAGNETTO 1967*, Camarazonosporites (C.) heskemensis* (PFLANZL 1955) KRUTZSCH 1959*, Ornatisporis belgicus* KRUTZSCH & VANHOORNE 1977 etc.

The Coniferals – as we already mentioned- have a poor participation. Among them, as a new element is the *Picea* pollen. Probably it reached the Paleocene lake from Jibou carried by the winds from the ancient highland areas in the Apuseni Mountains, already erected in Paleocene.

b. **The biostratigraphic** interpretation of the microflora complex from Jibou primarily concerns the Dicotyledonous Angiosperms. The frequency of: *Interpollis microsupplingensis* KRUTZSCH 1961*, Interpollis supplingensis* (PFLUG 1953) KRUTZSCH 1961*, Nudopollis thiergardti* PFLUG 1953, *N. endangulatus* PFLUG 1953*, N. terminalis* (THOMSON & PFLUG 1953) PFLUG 1953*, Plicapollis pseudoexcelsus* (KRUTZSCH 1958) KRUTZSCH 1960*, Triatripollenites coryphaeus coryphaeus* (POTONIÉ 1931) THOMSON & PFLUG 1953*, Anacolsidites pseudoefllatus* KRUTZSCH 1959*, Subtriporopollenites constans* PFLUG 1953*, S. annulatus* THOMSON & PFLUG 1953*, S. magnoporatus* (THOMSON & PFLUG 1953) KRUTZSCH 1960*, Tetrapollis validus* (PFLUG 1953) PFLUG 1953*, Stephanoporopollenites hexaradiatus semitribiniae* KRUTZSCH 1961 etc., is an evidence to affirm that the basal Rona Member succession belongs to the Late Paleocene (Late Paleocene). However, some forms can be also identified in the Early Eocene. About the signification of some palynomorphs in establishing the location of the Paleocene/Eocene boundary, one can find a lot of

interesting opinions in several works (*e.g*. Lenk 1961, Krutzsch 1966, Kedves et al., 1971, Gruas-Cavagnetto 1972, Roche 1973, Krutzsch & Vanhoorne, 1977, Mihailovic et al., 1980, Kedves 1986, Steurbaut et al., 1999, Zetter & Hofmann 2001).

c. The reconstruction of the Paleocene continental environment is based on the ecological exigencies of some actual descendent related with the fossils.

The Paleocene lake environment is documented by the high frequency of *Ovoidites* [*O. ligneolus minor* RAATZ 1937*, O. ligneolus intermedius* RAATZ 1937*, O. elongates* (HUNGER 1952) KRUTZSCH 1959]. The numerous colonies of *Botryococcus, Pediastrum*, as well as the *Hydrosporis levis* (HUNGER 1952) KRUTZSCH 1962 spores (originating from *Salvinia* Ferns*)*, indicate the same ancient lacustrine biotope.

The monoporate Sparganiaceae pollen – at least, a part of it- are related to the peripheral areas of the Paleocene lake.

In the favourable conditions, when the subsidence was optimum, the lake margins passed into swamps, where brown coal accumulated. However, the thickness of this coal never exceeds some centimetres. These events were cyclic because one can observe at least 3-4 thin coal or coal shale strata.

The Osmundaceae spores (*Baculatisporites primarius crassiprimarius* KRUTZSCH 1967), some of Schizeaceae, Polypodiaceae and a part of the small moos spores (*Stereisporites*) have to be related to the swamps that generated the coals.

Some Palms (*Dicolpopollis* etc) or a part of dicotyledonous (Myricaceae, Cyrilliaceae, Juglandaceae, Ericaceae) had an optimum during the swamp episodes.

It is worth to be mention that it is the first coal-generating swamp in the Early Cenozoic from Romania.

The identification of *Ephedripites* and *Chenopodipollis* pollen (it is true, documented by sporadic apparitions only) proves that inside the land areas xerophytic assemblages existed also.

d. The **interpretations on paleoclimate** can be outlined starting with the exigencies of some actual relatives of the fossil plants.

The <u>macrothermic elements</u> are well represented in the pollen complex.

The Fern spores are mainly well facies markers. However, among them, one can find some elements indicating the hot and wet environment. It mainly concerns the Schizeaceae spores [*Anemia, Lygodium* etc. or *Leiotriletes adriennis* (POTONIÉ & GELLETICH 1933) KRUTZSCH 1959*, L. microadriennis* KRUTZSCH 1959*, L. paramaximus* KRUTZSCH 1959*, Trilites multivallatus* (PFLUG 1953) KRUTZSCH 1959 etc].

The Palm pollen is considered as an appropriate macrothermic marker (in the Early Cenozoic and the warm Miocene episodes). If thinking at *Proxapertites* (in some samples, it reach 3 %) it worth to mention that it could be related with some actual Palms pollen belonging to the subfamilies Aroideae and Monsteroideae (*Gonatopus bovinii, G. angustus, Zamioculcas zamiifolia, Amydrium medium, Monstera deliciosa* etc.; Zetter et al. 2001).

The different *Proxapertites* species are mentioned along a very long time span: Late Cretaceous-Paleogene-Neogene. In the same manner, the geographic distribution with *Proxapertites* pollen is also very wide: South and North Americas, Asia, Africa and Europe (Zetter et al. 2001).

The same exigencies should be valid for the Palm dicolpate pollen (*Dicolpollis*) or the monocolpate one [*Monocolpopollenites tranquillus* (POTONIÉ 1934) THOMSON & PFLUG 1953*, M. magnus* KEDVES 1961*, Arecipites parareolatus* (KRUTZSCH 1958) KRUTZSCH 1970*, Arecipites* sp.].

The macrothermic Dicotyledonous pollen is represented by families Bombacaceae (*Bombacacidites*), Olacaceae (*Anacolosidites*), Cyrillaceae (*Cyrilliaceaepollenites*), Icacinaceae (*Compositoipollenites rhizophorus*), Sapotaceae (*Tetracolporopollenites.*) etc.

The Normapolles pollen group –at least a part of it- indicate the same macrothermic frame.

The <u>mesothermic elements</u> have an important role into the Paleocene pollen spectrum from Jibou, mainly due to their diversity. The majority are rare or sporadic: *Caryapollenites, Pterocaryapollenites, Intratriporopollenites* etc. Some exotic oaks are however, frequents: *Tricolporopollenites cingulum* (POTONIÉ 1931) THOMSON & PFLUG 1953*, Tricolpopollenites liblarensis* (THOMSON 1950) THOMSON & PFLUG 1953 etc.

The <u>arctotertiary elements</u> are also present in the microfloristic assemblage from Jibou, but they are subordinate. It concerns *Pinus* (sg. *diploxylon*) that appear rarely in some samples, or the bisaccate pollen related to *Picea* (*Piceapollis*), which is sporadic.

Among the Dicotyledonous Angiosperms it worth to be mentioned as well defined microthermic elements: *Betula* (*Trivestibulopollenites betuloides* PFLUG 1953), *Alnus* [*Polyvestibulopollenites verus* (POTONIÉ 1934) THOMSON & PFLUG 1953 etc].

These arctotertiary elements suggest an altitude distribution of the Paleocene vegetation. The Coniferal level probably belonged to *Picea*. This level could correspond to the ancient Apuseni M-ts highlands that constituted the source area for the wide debris amount resulted after intensive erosion.

All these arguments indicate that the source vegetation for the Paleocene pollen and spores

evolved in a warm climate, subtropical/tropical-like, at middle paleolatitude. This vegetation belonged to PETM (Paleocene/Eocene Thermal Maximum), a geological event mentioned by Collinson et al. (2002). The forests that evolved at Paleocene/Eocene boundary were subtropical/tropical; later, in Eocene, true tropical forests installed, megathermic, with mangroves.

Berggren et al. (1998) considered that toward the Paleocene/Eocene boundary took place a global warming (contrasting with the Eocene/Oligocene boundary cooling). In their opinion, the global marine surfaces warmed: the equatorial marine water temperature exceeded 20°C in Pacific and 26°C in Carribean Sea.

The Paleocene vertebrate fauna from Jibou (Gheerbrant et al., 1999; Codrea et al., 2003) evidence a lake with warm water, in the same subtropical/tropical climate.

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Table 1.

#	Taxa	Frequency
	PHYTOPLANKTON	
1	*Ovoidites ligneolus minor* RAATZ 1937	++
2	*O. l. intermedius* RAATZ 1937	++
3	*O. elongatus* (HUNGER 1952) KRUTZSCH 1959	++
4	*Botryococcus* sp.	+++
5	*Pediastrum* sp.	++
	SPORITES	
1	*Leiotriletes adriennis* (POTONIÉ & GELLETICH 1933) KRUTZSCH 1959	+
2	*L. microadriennis* KRUTZSCH 1959	+++
3	*L. wolffi* KRUTZSCH 1962	+
4	*L. microlepioidites* KRUTZSCH 1962	+
5	*L. paramaximus* KRUTZSCH 1959	**x**
6	*L. maxoides* KRUTZSCH *1962* palaeogenicus KEDVES *1973*	x
7	*Leiotriletes* sp. (cf. *L. balinkaense pseudoundulatus* KEDVES 1973)	x
8	*Leiotriletes* sp. (cf. *L. bakonyensis* KEDVES 1973)	x
9	*Triplanosporites microsinuosus* PFLANZEL 1955	++
10.	*T. sinousus* KRUTZSCH *1962*	+
11.	*T. sinomaxoides* KRUTZSCH 1962	**x**
12.	*Toroiosporis* (*Duplotoroiosporis*) *solutionis* KRUTZSCH 1959	**x**
13.	*T.* (*T*) *aneddeni* KRUTZSCH 1959	**x**
14.	*Trilites multivallatus* (PFLUG 1953) KRUTZSCH 1959	**x**
15.	*Ischyosporites microfovearis* (KRUTZSCH 1959) KRUTZSCH & VANHOORNE 1977	**x**
16.	*Favoisporis* sp.	x
17.	*Concavisporites (Obtusisporis) minimus* KRUTZSCH 1962	+
18.	*Intrapunctisporis gracilioides* KRUTZSCH & VANHOORNE 1977	**x**
19.	*Extrapunctatosporis seydaensis* KRUTZSCH 1967	**x**
20.	*E. microalveolatus* KRUTZSCH 1967	**x**
21.	*Verrucatosporites favus* (POTONIE 1931) THOMSON & PFLUG 1953	**x**
22.	*Camarazonosporites (C.) heskemensis* (PFLANZL 1955) KRUTZSCH 1959	**x**
23.	*Baculatisporis primarius crassiprimarius* KRUTZSCH 1967	**x**
24.	*Polypodiaceoisporites marxheimensis* (MÜRRIGER & PFLUG 1913) KRUTZSCH 1953	++
25.	*P. loksbergensis* KRUTZSCH & VANHOORNE 1977	**x**
26.	*P.* sp. (cf. *P. rectolatus* NAGY 1963)	**x**
27.	*Verrucingulatisporites* sp.	**x**
28.	*Ornatisporites belgicus* KRUTZSCH & VANHOORNE 1977	**x**
29.	*Laevigatisporites bisulcatoides* KRUTZSCH 1967	+
30.	*L. gracilis* WILSON & WEBSTER 1946	+
31.	*L. haardti* (POTONIÉ & VENITZ 1934) THOMSON & PFLUG 1953	+++
32.	*L. rochei* CAVAGNETTO 1967	+
33.	*L. adiscordatus* KRUTZSCH 1959	+
34.	*L. discordatus* PFLUG 1953	+
35.	*L. nutidus* (MAMCZAR 1960) KRUTZSCH 1967	+
36.	*Polypodiidites secundus* (POTONIÉ 1934) KRUTZSCH 1963	+
37.	*Microfoveolatosporis pseudodentatus* KRUTZSCH 1959	+
38.	*Hydosporis levis* KRUTZSCH 1962	**x**
39.	*Stereisporites (St.) stereoides* (POTONIÉ & VENITZ 1934) THOMSON & PFLUG 1953	++
40.	*St. (St.) eovalidus* KRUTZSCH & VANHOORNE 1977	+
41.	*St. (St.) involutus* (DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH 1963	+
	POLLENITES	
	GYMNOSPERMAE	
1.	*Pityosporites microalatus* (POTONIÉ 1931) THOMSON & PFLUG1953	+
2.	*P. labdacus* (POTONIÉ 1931) THOMSON & PFLUG 1953	+
3.	*Pityosporites* sp.	**x**
4.	*Cedripites* sp.	**x**

5.	*Podocararpidites* sp.	**x**
6.	*Inaperturopollenites* sp. (tip *hiatus*) (POTONIÉ 1931) THOMSON & PFLUG 1953	**x**
7.	*Piceapollis* sp. (tip *tobolicus*) (PANOVA1966) KRUTZSCH 1971	**x**
8.	*Ephedripites (D.) fusiformis* (SCHAKMUNDES 1965) KRUTZSCH 1976	**x**
	ANGYOSPERMAE	
	Monocotyledonous	
1.	*Sparganiaceaepollenites cuvillieri* (CAVAGNETTO 1966) ROCHE1968	+
2.	*S. reticulatus (*DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH & VANHOORNE 1977	++
3.	*Graminidites* sp.	**x**
4.	*Monocolpopollenites tranquillus* (POTONIE 1934) THOMSON & PFLUG 1953	++
5.	*M. magnus* KEDVES 1961	+
6.	*Monocolpopollenites* sp.	+
7.	*Arecipites parareolatus* (KRUTZSCH 1958) KRUTZSCH 1970	+
8.	*Arecipites* sp.1	**x**
9.	*Arecipites* sp.2	**x**
10.	*Dicolpopollis* sp.	**x**
11.	*Proxapertites operculatus* VAN DER HAMMEN 1956	+
12.	*Cycadopites* cf. *cycadioides* (ZAKLINSKYA 1957) KEDVES 1968	x
	Dicotyledonous	
1.	*Magnolipollis neogenicus* KRUTZSCH 1970	**x**
2.	*Liriodendroipollis semiverrucatus* KRUTZSCH 1970	**x**
3.	*Interpollis supplingensis* (PFLUG 1953) KRUTZSCH 1961	++
4.	*I. microsupplingensis* KRUTZSCH 1961	+
5.	*Stephanoporopollenites hexaradiatus semitribinae* KRUTZSCH 1961	**x**
6.	*Tetrapollis vallidus* (PFLUG 1953) PFLUG 1953	**x**
7.	*T. polyangulus* (PFLUG 1953) KRUTZSCH 1967	+
8.	*Slowakipollis* cf. *eleagnoides* KRUTZSCH 1962	**x**
9.	*Basopollis* sp.	+
10.	*Nudopollis terminalis* (THOMSON & PFLUG 1953) PFLUG 1953	+
11.	*N. endangulatus* PFLUG 1953	+
12.	*N. thiergarti* PFLUG 1953	+
13.	*Plicapollis pseudoexcelsus* (KRUTZSCH 1958) KRUTZSCH 1960	+++
14.	*Pentapollenites triangulus* KRUTZSCH 1962	**x**
15.	*P. regulatius* KRUTZSCH 1962	+
16.	*Gothanipollis gothanii* KRUTZSCH 1959	**x**
17.	*Olaxipollis mathesi* KRUTZSCH 1962	**x**
18.	*Cupanieidites eucalyptoides* KRUTZSCH 1962	**x**
19.	*Anacolosidites pseudoefflatus* KRUTZSCH 1959	**x**
20.	*Triatriopollenites coryphaeus coryphaeus* (POTONIÉ 1931) THOMSON & PFLUG 1953	++
21.	*T. labraferoides* KRUTZSCH 1960	**x**
22.	*T. rurensis* PFLUG & THOMSON 1953	++
23.	*Platyacaryapollenites levis* (POTONIÉ 1931) KRUTZSCH 1969	+
24.	*Platyacaryapollenites* sp.	+
25.	*Momipites quietus* (POTONIÉ 1934) KRUTZSCH 1972	x
26.	*Plicatopollis plicatus* (POTONIÉ 1934) KRUTZSCH 1962	+
27.	*P. lunatus* KEDVES 1974	**x**
28.	*P. minor* KEDVES 1974	**x**
29.	*Caryapollenites praesimplex* KRUTZSCH & VANHOORNE 1977	**x**
30.	*C. simplex* (POTONIÉ 1931) RAATZ 1937	**x**
31.	*Pterocaryapollenites stellatus* (POTONIÉ 1931) RAATZ 1937	**x**
32.	*Subtriporopollenites constans* PFLUG 1953	+++
33.	*S. anulatus* THOMSON & PFLUG 1953	++
34.	*S. subporatus* KRUTZSCH 1960	+
35.	*S. magnoporatus* (THOMSON & PFLUG 1953) KRUTZSCH 1960	+
36.	*S. intrastructurus* KRUTZSCH & VANHOORNE 1977	**x**
37.	*S. reticulatus* KRUTZSCH & VANHOORNE 1977	**x**
38.	*Intratriporopollenites microreticulatus* MAI 1961	+
39.	*I. cecilensis* KRUTZSCH 1960	**x**
40.	*Bombacacidites* gr. *kettingensis* (PFLUG 1953) KRUTZSCH 1960	**x**

41.	*Compositoipollenites rhizophorus* POTONIÉ 1960	++
42.	*Polyvestibulopollenites verus* (POTONIÉ 1934) THOMSON & PFLUG 1953	**x**
43.	*Trivestibulopollenites betuloides* PFLUG 1953	**x**
44.	*Porocolpopollenites microvestibulum* KRUTZSCH 1960	**x**
45.	*Reevesiapollis eocaenicus* KRUTZSCH 1970	**x**
46.	*Tricolpopollenites liblarensis* (THOMSON 1950) THOMSON & PFLUG 1953	++
47.	*Tricolporopollenites paramularius* (POTONIÉ 1934) KRUTZSCH 1960	+
48.	*T. moorkensii* ROCHE 1973	**x**
49.	*T. pseudoiliacus* KRUTZSCH & VANHOORNE 1977	+
50.	*T. eocaenicus* KRUTZSCH & VANHOORNE 1977	**x**
51.	*T.* cf. *eomaximus* KRUTZSCH & VANHOORNE 1977	**x**
52.	*T. cingulum* (POTONIE 1931) THOMSON & PFLUG 1953	++
53.	*T. pseudocingulum* (POTONIÉ 1931) THOMSON & PFLUG 1953	**x**
54.	*Bacutricolporites steinensis* (PFLUG 1953) KEDVES 1978	**x**
55.	*Cyrillaceaepollenites exactus* (POTONIÉ 1931) POTONIÉ 1960	+
56.	*C. megaexactus* (POTONIÉ 1931) POTONIÉ 1960	**x**
57.	*Rhoipites rousi* (NAKOMAN 1966) KEDVES 1978	**x**
58.	Tetracolporopollenites *sp.*	**x**
59.	*Chenopodipollis multiplex* (WEYLAND & PFLUG 1957) KRUTZSCH 1966	**x**
60.	*Ericipites* cf. *ericius* (POTONIÉ 1931) POTONIÉ 1960	+
61.	*E. callidus* (POTONIÉ 1931) KRUTZSCH 1970	+

Frequency: x- sporadic (1-2 grains); + - rare (3-9 grains); ++ - frequent (10-20 grains) +++ - very frequent (more than 20 grains)

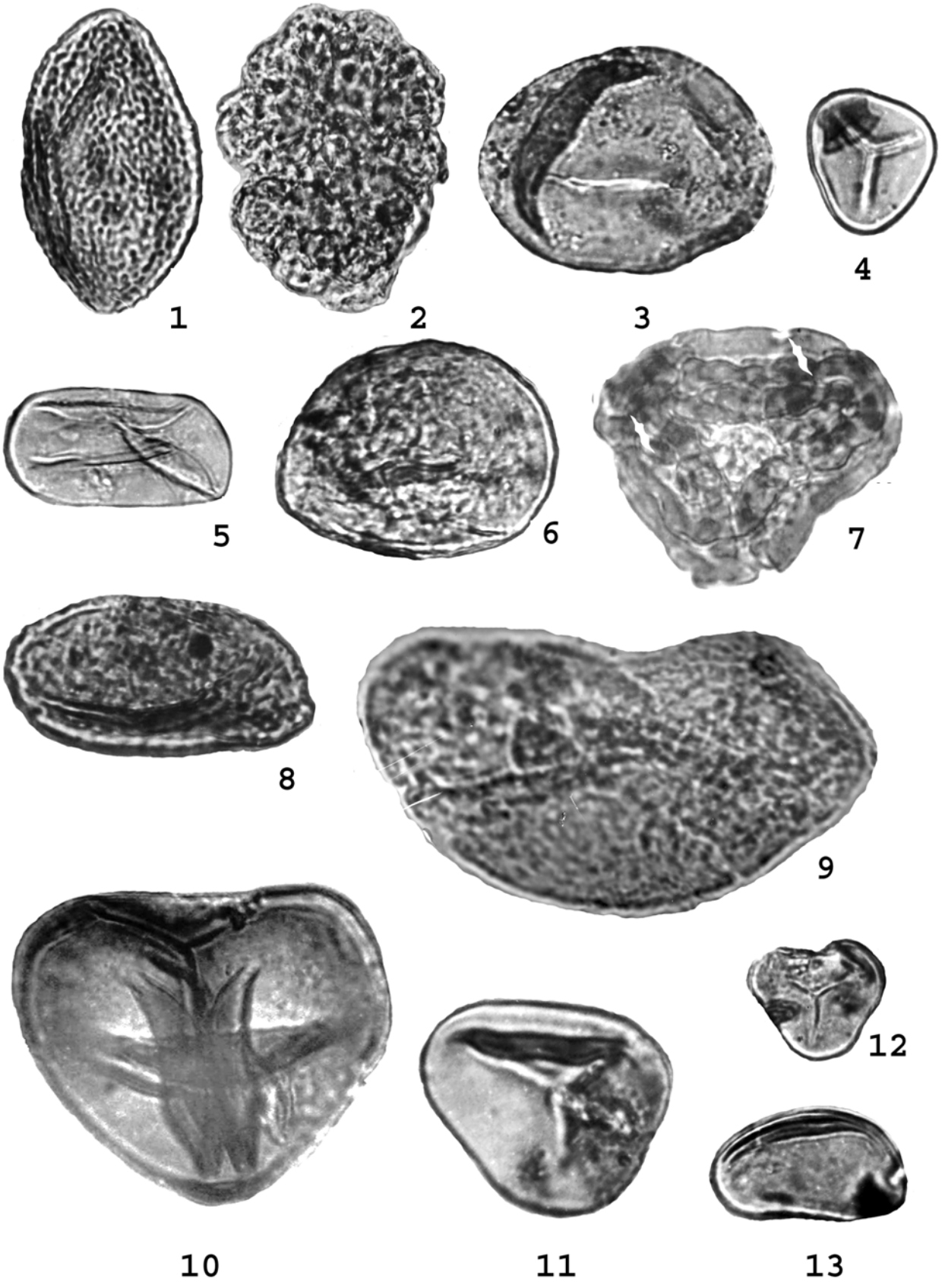
PLATES

PLATE I (1000 X)

1. *Ovoidites ligneolus minor* 2. *Botryococcus* sp. 3. *Laevigatisporites discordatus* 4. *Stereisporites stereoides* 5. *Laevigatisporites bisulcatoides* 6. *Polypodiidites secundus* 7. *Ornatisporis belgicus* 8. *Microfoveolatosporis pseudodentatus* 9. *Piceapollis* sp. 10. *Leiotridetes paramaximus* 11. *L. microadriennis* 12. *L. microlepioidites* 13. *Laevigatisporites haardti*

PLATE II (1000 X)

1 *Proxapertites operculatus* 2. *Monocolpopollenites tranquillus* 3. *M. magnus* 4. *Subtriporopollenites constans magnus* 5. S*. c. constans* 6. *S. c. inversus* 7. *S. constans* 8. *S. anulatus* 9. *Interpollis microsupplingensis* 10. *I. supplingensis* 11. *Bombacacidites* gr. *kettingensis* 12. *Triatriopollenites coryphaeus* 13. *Plicatopollis plicatus* 14. *P. lunatus* 15. *Plicatopollenites pseudoexcelsus* 16. *Compositoipollenites rhizophorus* 17. *Platycaryapollenites levis* 18. *Nudopollis terminalis* 19. *Pentapollenites triangulus* 20. *Intratriporopollenites microreticulatus* 21. *Triatriopollenites rurensis* 22. *Gothanipollis gothani* 23. *Ericipites ericius* 24. *Tricolpopollenites liblarensis* 25. *Tricoloporopollenites cingulum*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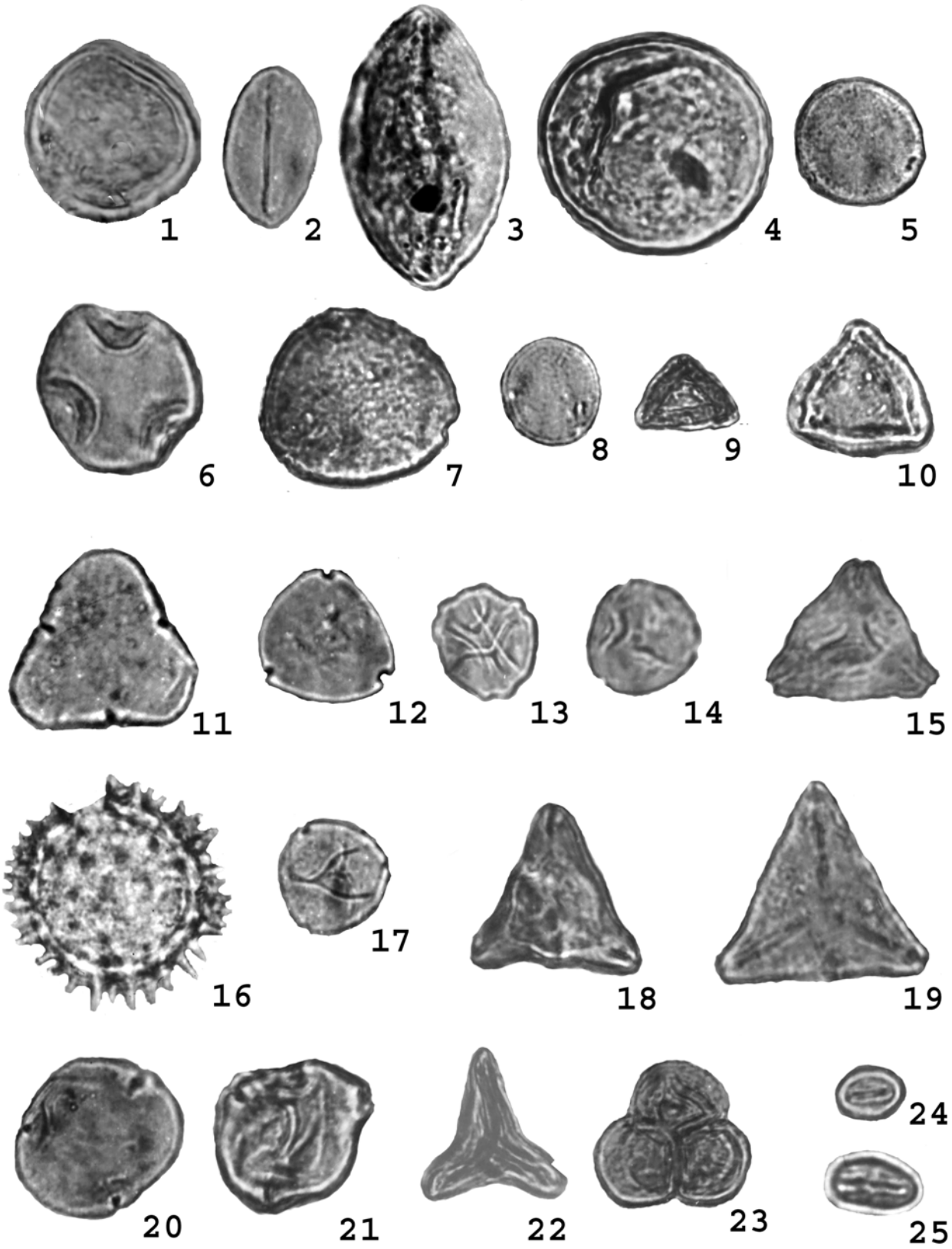
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