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PALYNOLOGICAL DATA ABOUT THE PRESENCE OF THE FAMILY *SYMPLOCACEAE* IN THE MIOCENE OF NORTHWESTERN BULGARIA

DIMITER A. IVANOV

Institute of Botany, Bulgarian Academy of Sciences, 1113 - Sofia, Bulgaria

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Abstract: Four types and one subtype of fossil pollen from the genus *Symplocos* were recovered from three boreholes in Northwestern Bulgaria for the first time in this region. The fossil pollen are compared to recent pollen types. The distribution of the genus in the Bulgarian fossil flora, based both on the palynological and on the macropaleobotanical data, is presented.

Keywords: Miocene, Bulgaria, palynology, paleobotany, *Symplocos*.

Introduction

Large scale studies on the Neogene flora have been undertaken on the bases of spore and pollen analyses in Northwestern Bulgaria in recent years (in connection to the IGCP - 329 of UNESCO: "Paleogeographical and paleoecological evolution of the Paratethyan basins during the Neogene and their correlation to the global scales"). Yet the publication of the final results will probably be delayed for some time, owing to the vast amount of samples which have still to be studied. It is for this reason that we intend to give certain preliminary reports on those facts, established by us, which are of a definite interest from a paleobotanical or a biostratigraphical point of view. The subject of this preliminary communication is *Symplocaceae*, the fossil pollen of which was found in samples of Miocene sediments from Northwestern Bulgaria.

The *Symplocaceae* are a monotypic family, represented in the recent flora only by the genus *Symplocos*, which includes about 300-400 species (Krutzsch 1989). The latter are distributed throughout the tropical and subtropical regions of Asia, Australia, New Caledonia and America, but nowhere in Africa and West Asia. They grow in the undergrowth in deciduous and evergreen forests, in shrub communities and in open spaces, along the margin of mangrove communities, and along the banks of rivers and streams.

Krutzsch (1989) discussed the paleochorology of genus *Symplocos* on the basis of the paleocarpological and paleopalynological data. According to him, the genus began in California during the Late Cretaceous, gradually extending eastwards and occupying yet new habitats in the humid and warm Northern Tethyan flora belt. Towards the end of the Eocene, *Symplocos* reached as far as Japan. During the Oligocene/Miocene the area disintegrated into three separated parts: North America, Europe and East-Southeast Asia. The further development of the genus is characterized by its disappearing from European paleofloras during the Pleistocene, and by the formation of two new centers of distribution. The first one was formed during the Pliocene, when vast territories of South America were occupied by *Symplocos* as a result of migration from North America through the Central American permanent land bridge. Another very young, secondary center of distribution was formed during the Pleistocene in the East-Southeast Asian and Western Pacific region.

In Europe about 25 *Symplocos* species from the Tertiary have been established as macrofossils. Probably, the pollen species are not fewer in number but their description is not accurate in all the cases, and, on the other hand, pollen of *Symplocos* often remains "hidden" behind names disguising their actual botanical appurtenance. A critical treatise on the fossil pollen can be found in Muller (1981).

The present study makes an attempt to identifying the fossil pollen, through a comparison with recent pollen types.

Materials and methods

Materials from three boreholes (Fig. 1) in Northwestern Bulgaria (Montana district) were studied: C-1, the village of Slavotin; C-37, the village of Macresh, and C-12, the village of Deleina (Fig. 1). The studied parts of the drillings comprise marine sediments of Badenian and Sarmatian age from the South-Eastern part of the Central Paratethys basin. During the Miocene, four large structural paleogeographical regions existed in Northwestern Bulgaria (Kojumdgieva et al. 1978). The sediments studied originate from Marginal stable region near the borderline of a Miocene longitudinal depression.

The materials were processed following standard methodology for disintegrating Tertiary sediments and acetolysis after Erdtman (1952). The presence of *Symplocos* pollen was established in the sediments both of Badenian and Sarmatian age (Tab. 1).

The following abbreviations are used in the text: E - equatorial diameter, Da - apocolpium diameter, PI - polar index = Da / E.

Results

Data on the recent pollen of genus *Symplocos* have been published by a number of authors (Erdtman 1952; van der Meijden

Fig. 1. Map of the investigated region.

1970; Barth 1979, 1982; Lieux 1982; Mai 1986). The most comprehensive investigation is that of van der Meijden (1970), who described two pollen types in genus the *Symplocos*, corresponding to the two subgenera *Symplocos* and *Hopea*. Two subtypes were recognised in the first type, and nine subtypes in the second one. The pollen subtypes are morphologically well differentiated and easy to identify. In our opinion, they should, therefore, be regarded as pollen types characteristic of the corresponding two subgenera. This approach has been adopted in connection with the descriptions of the fossil pollen below.

Symplocos cochinchinensis type
(Pl. I: Figs. 1, 2)

Tricolporate pollen grains; NPC = 345. Outlines: rounded to rounded-triangular in polar view. Measurements: E = 29.0-31.5 µm, Da = 15 µm, PI = 0.52. Apertures: ectoapertures - colpi; endoapertures - ore, ± rounded (or slightly lalongate), with a diameter about 4.0 µm. Exine: 1.1 µm thick between apertures, tectate; sexine : nexine = 1.2 : 1; columellae indiscernible. Ornamentation: scabrate to granulate, with small, thin echini, clearly visible in optical section; sculptural elements with dimensions of about and below 1.0 µm. *Symplocos* hab. F of Menke (1976) can also be included in the same type.

Age: Volhynian - Late Bessarabian.

Geographical distribution: The recent species belonging to this type (van der Meijden 1970) are spread throughout continental and East Asia - from Sri Lanka to Japan, Malaysia, and Queensland.

Symplocos paniculata type
(Pl. I: Figs. 3, 4)

Tricolporate pollen grains; NPC = 345. Outlines: rounded-triangular to almost rounded in polar view. Measurements: E = 39.0-42.5 µm, Da = 15 µm, PI = 0 37. Apertures: ectoapertures - colpi, endoapertures - ore, ± rounded (or lalongate), with a diameter about 7.0 µm. Exine: 2.1 µm between apertures, tectate; sexine : nexine = 2 : 1. Ornamentation: verrucate, verrucae with a diameter of 2.2-3.5 µm. Van der Meijden (1970) quoted ornamentation "reticulate and pitted". In our opinion, the ornamentation is verrucate, and the arrangement of the verrucae makes it reticulate in appearance, yet no real reticulum is formed. The fossil pollen differs from the type only by its measurements, yet in the description of the type (van der Meijden 1970) only the average measurements are quoted, no lower or upper limit of variability being named. Nevertheless, the ornamentation and outlines of the pollen grains in polar view facilitate their definition. The *Symplocos* hab. E, described by Menke (1976), no doubt belongs to this type.

Age: Early Volhynian - Late Bessarabian.

Geographical distribution: The recent species of the same name, belonging to this type, is spread throughout China and Korea.

Symplocos alata type
(Pl. I: Figs. 5, 6)

Tricolporate pollen grains; NPC = 345. Outlines: triangular in polar view, angles widely rounded. Measurements: E = 30.0-38.0 µm, Da = 20.0-25.0 µm, PI = 0.65. Apertures: ectoapertures - colpi; endoapertures - ore, ± rounded, with a diameter 6.0-7.0 µm. Exine: 1.5-1.9 µm thick between apertures, tectate; sexine : nexine = 1.5 : 1 to 1.2 : 1; columellae clearly visible. Ornamentation: verrucate, verrucae with a diameter of 1.0-2.0 µm arrangement of the verrucae gives the exine a reticulate pattern. The pollen types of Menke (1976) *Symplocos* hab. B-D belong to this type.

Age: Badenian - Late Bessarabian.

Table 1: Fossil finds of genus *Symplocos* in the Miocene of Bulgaria.

TAXON	TYPE OF FOSSILS	LOCALITIES	AGE
Symplocos lignitarum (Quenst.) Kirchh.	seeds	Čukurovo, SW Bulg.	Badenian
Symplocos minutula (Stern.) Kirchh.	seeds	Čukurovo, SW Bulg.	Badenian
Symplocos salzhausensis (Ludw.) Kirchh.	seeds	Čukurovo, SW Bulg.	Badenian
Symplocos simile Kolak.	leaves	Ružinci, NW Bulg.	Volhynian
Symplocos cochinchinensis type	pollen	Deleina, NW Bulg.	Volhynian - Late Bessarabian
Symplocos paniculata type	pollen	Deleina, NW Bulg.	Early Volhynian - Late Bessarabian
Symplocos alata type	pollen	Deleina, Slavotin, Macrech, NW Bulg.	Badenian - Late Bessarabian
Symplocos tinctoria subtype	pollen	Deleina, Slavotin, Macrech, NW Bulg.	Late Volhynian - Late Bessarabian
Symplocos type A	pollen	Deleina, NW Bulg.	Late Volhynian - Late Bessarabian

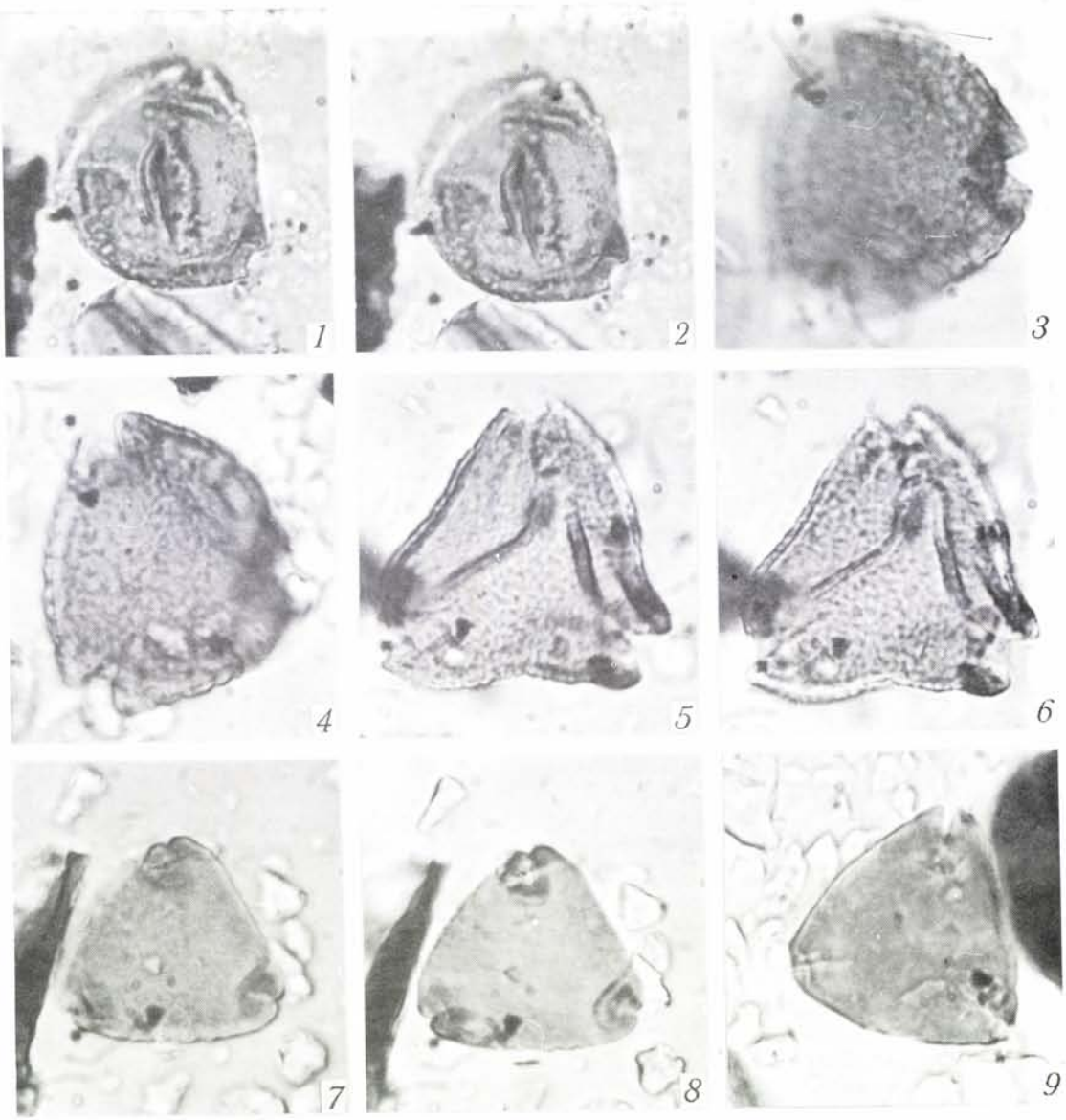

Plate 1: Figs. 1, 2. *Symplocos cochinchinensis* type: 1 - Ornamentation at high focus; 2 - Optical cross-section. (Deleina, C-12: 106.0 m; Upper Bessarabian). **Figs. 3, 4.** *Symplocos paniculata* type: 3 - Ornamentation at high focus; 4 - Optical cross-section. (Deleina, C-12: 114.0 m; Upper Bessarabian). **Figs. 5, 6.** *Symplocos alata* type: 5 - Ornamentation at high focus; 6 - Optical cross-section. (Slavotin, C-1: 241 m; Lower Volhynian). **Figs. 7, 8.** *Symplocos tinctoria* subtype: 7 - Ornamentation at high focus; 8 - Optical cross-section. (Slavotin, C-1: 240 m; Lower Volhynian). **Fig. 9.** *Symplocos* type A. Optical cross-section. (Deleina, C-12: 114.0 m; Upper Bessarabian). Magnification 1000×.

Geographical distribution: The recent species belonging to this type (van der Meijden 1970) are spread throughout Burma, China, Hainan, and Japan.

Symplocos tinctoria subtype
(Pl. I: Figs. 7, 8)

Tricolporate pollen grains; NPC = 345. Outlines: triangular in polar view, angles widely rounded. Measurements: E = 31.0–32.5 μm, Da = 17 μm, PI = 0.57. Apertures: ectoapertures - colpi; endoapertures - ore, ± rounded, with a diameter about 5.0 μm. Exine: 0.9 μm between apertures, thickened around ore, tectate; sexine : nexine = 1.2 : 1; exine layers hardly discernible. Ornamentation: scabrate, sculptural elements resemble small, flattened verrucae, practically immeasurable. According to Lieux (1982) the ornamentation is nannoverrucate.

Van der Meijden (1970) and Mai (1986) point out the difference of the pollen of *S. tinctoria* in the type *S. alata*, while Lieux (1982) describes it as a Type: 63. In our opinion, the pollen of *S. tinctoria* can be regarded as a subtype of the *S. alata* type, possessing all the features of the type, but differing markedly in the size of the sculptural elements. The pollen of the recent species *S. tinctoria*, differs from the fossil pollen only in the exine thickness.

Age: Late Volhynian - Late Bessarabian.

Geographical distribution: The recent species *S. tinctoria* is spread throughout North America.

Symplocos type A.
(Pl. I: Fig. 9)

Tricolporate pollen grains; NPC = 345. Outlines: triangular in polar view, angles rounded. Measurements: E = 32.0-34.0 µm, Da = 13 µm, PI = 0.4. Apertures: ectoapertures - colpi, groove-like; endoapertures - ore, ± rounded, with a diameter about 5.0 µm. Exine: 0.9 µm thick between apertures, tectate; exine layers hardly discernible. Ornamentation: psilate.

Comparison with the Brazilian *Symplocos* pollen types (Barth 1982) shows a correspondence of this pollen type with the recent *Symplocos tenuifolia* type on the base of simple exine and smooth tectum. But the fossil pollen differs from the recent one by the thinner exine, by the smaller apocolpium diameter, and by longer colpi.

This pollen type can be compared to *Porocolpopollenites hidasensis* Nagy 1963, established in Badenian and Sarmatian sediments in Hungary (Nagy 1985).

Age: Late Volhynian - Late Bessarabian.

Notes on the composition of the *Symplocos* in the Bulgarian fossil flora

The oldest fossil record of the genus *Symplocos* in Bulgaria dates back to the Late Eocene (Černjavska 1967). This author established the presence of *Porocolpopollenites vestibulum* (R. Potonié 1931a) Th. & Pfl. 1953 in Upper Eocene sediments near Belene, Northeastern Bulgaria. On the base of its description and the microphotographs, that pollen may be referred to *Symplocos paniculata* type. The distribution of this taxon from the Upper Eocene to the beginning of the Miocene in South Bulgaria has been traced by Černjavska (1977, Fig. 7).

In the Miocene sediments in Bulgaria (Tab. 1), four *Symplocos* species have been established as macrofossils so far (Palamarev 1971; Palamarev & Petkova 1977; Palamarev 1989). Three of them were found during paleocarpological investigations of the Middle Miocene (Badenian) sediments from the Čukurovo Basin (Palamarev 1971; Palamarev 1989). These are the species *S. lignitarum* (Quensted 1876) Kirchheimer 1957; *S. minutula* (Sternberg 1825) Kirchheimer 1949 and *S. salzhausensis* (Ludwig 1860) Kirchheimer 1939. As stated by their author, the latter two species are morphologically related respectively, to the recent *S. tinctoria* L'Herit and *S. paniculata* Wall., which were also documented in the present investigation. In the Miocene (Volhynian) of Northwestern Bulgaria (near the village of Ruzinci, Fig. 1) Palamarev & Petkova (1987) leaf fossils of *S. simile* Kolak. 1976, morphologically akin to the recent *S. japonica* A. DC. and *S. macrocarpa* Wight, were found. Regretfully, we have no available data about the pollen of these recent analogues, nor about the recent analogue of *S. lignitarum* - *S. toarensis* Guill., for a comparison of their pollen with the established fossil pollen to be made.

Conclusion

During the palynological investigations on the Miocene sediments from Northwestern Bulgaria, four types and one subtype of pollen of genus *Symplocos* were established, all of them belonging to the subgenus *Hopea*. This contributes to the information about the distribution of genus *Symplocos* in the Miocene in Bulgaria, obtained from macropaleobotanical investigations. The evidently considerable species variety of the genus shows the presence of favorable conditions for its existence during the Miocene on the territory of Northwestern Bulgaria.

In Northwestern Bulgaria the *Symplocos* species developed as components of the hygrophytic to mesohygrophytic forest, which existed in the region in the Miocene, probably in the oak-magnolia and the mixed paleocommunities (Palamarev 1991). They grew in communities composed of a large number species and genera - *Magnolia, Liriodendron, Quercus, Fagus, Castanea, Eucommia, Cornus, Carpinus, Pteris, Lygodium, Parthenocisus* and many others that are preserved both as macrofossils (Palamarev 1991), and as spores and pollen (Ivanov, unpubl. data).

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