

PALYNOLOGIC INVESTIGATIONS ON THE FRESHWATER LIMESTONE LAYER OF LÁBATLAN, AND AN ATTEMPT TO DIVIDE THE HUNGARIAN LOWER EOCENE FLORAS ON PALYNOLOGIC BASIS

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Introduction

The Hungarian analytical investigations on pollen of the Lower Eocene (Sparnat) are restricted up to now mostly to the coal basin of Dorog (5, 6). But we have also data about the Lower Eocene of Halimba (3, 7) and H. DEÁK (2) gives us in her paper on the Bauxit of Gánt some information about that territory. The investigations on the Lower Eocene coal deposits of Dorog, on those of Halimba (5, 6, 7), and the as yet unpublished results of the observations made on the strata of the Lower Eocene of Dudar have raised up numerous problems:

1. Was the Lower Eocene flora of Hungary uniform or were at least the dominating elements generally distributed?

2. Did an identical vegetation contribute to the formation of coal deposits of identical age, i. e. were the ecological conditions at a given time identical?

3. Is it thus possible to identify all the Lower Eocene strata of Hungary on a palynological basis by their pollenspectra; or are the results of pollen stratigraphy valid only to certain territories, in an identical age (Lower Eocene)?

4. Is it possible to characterize an age by individual spores and pollen or by their associations, respectively, by a stratigraphic diagram, constructed on the basis of the pollen spectra synthesis of the contemporary fossil floras of the different territories?

Essentially, the above mentioned problems are connected with the fundamental theses of pollen stratigraphy, however, we have also to deal with them from a critical point of view so as not to draw erroneous stratigraphic conclusions from some local differences.

Material and Method

To solve these problems, it seemed most suitable to investigate the Lower Eocene freshwater limestone of Lábatlan. I want here to express my appreciation to DR. I. MIHÁLTZ who supplied me with the material for the investigations. The sample had been taken east of the cement works of Lábatlan, from the somewhat discordantly settled freshwater limestone layers underneath the gravelly-sandy bed of the sandpit on the eastern part of the valley.

The preparation has been done with dil. HNO_3 , quantity of material used: 5 g.

Results

The preparation shows many amorphous organic remains but comparatively few spores and pollen. On 10 slides (18×18 mm) there were altogether 57 microfossils to be found; 24 of them are spores of fungi.

With pollen I use the nomenclature of THOMSON & PFLUG (14), with spores that of KRUTZSCH (9).

Remains of fungi	24
<i>Leiotriletes adriennis</i> (R. POT. & GELL. 1933) KRUTZSCH 1959 subfsp.	
<i>pseudomaximus</i> (TH. & PF. 1953) KRUTZSCH 1959	2
<i>Leiotriletes regularis</i> (PF. 1953) KRUTZSCH 1959	1
<i>Leiotriletes</i> fsp. indet.	1
<i>Inaperturopollenites dubius</i> (R. POT. & VEN.) TH. & PF.	9
<i>Inaperturopollenites magnus</i> (R. POT.) TH. & PF.	1
<i>Monocolpopollenites tranquillus</i> (R. POT.) TH. & PF.	18
<i>Monocolpopollenites zieveiensis</i> (PF.) TH. & PF.	1

Discussion

The demonstrated spores and pollen are undoubtedly of allochthonous origin, coming from freshwater limestone. It is certain that the forms that have fallen into the limestone at the time of its formation show the original conditions; the possibility of secondary soiling can be excluded.

To the remains of fungi stratigraphic significance cannot be ascribed. Of the spores of *Pteridophytes* the following: *Leiotriletes adriennis* (R. POT. & GELL. 1933) KRUTZSCH 1959 subfsp. *pseudomaximus* (TH. & PF. 1953) KRUTZSCH 1959, *Leiotriletes regularis* (PF. 1953) KRUTZSCH 1959 occur also in the Hungarian Tertiary, in the Miocene of Salgótarján, as the investigations of SIMONCSICS (12, 13) have shown; so these are also, in these circumstances, not characteristic features for a narrow period. *Leiotriletes* fsp. recorded here, is an extraordinarily corroded specimen but probably belongs to the „*adriennis*” group. As this spore could not be closely investigated, it cannot have any significance either.

The relatively great number of *Cupressaceae-Taxodiaceae* pollen (*Inaperturopollenites dubius* (R. POT. & VEN.) TH. & PF.) indicates the presence of a wet (moist) wood in the surrounding country. As it is well known, these pollen are to be found in large quantities rather in the Middle Tertiary, when these trees were playing an important role in the formation of the brown-coal deposits. *Inaperturopollenites magnus* (R. POT.) TH. & PF. is represented by the greatest number of specimens, the quantity of *M. zieveiensis* (PF.) TH. & PF. is not significant, but it has to be mentioned that in the opinion of DURAND (4) this form is characteristic for the Lower Tertiary deposits.

Though *M. tranquillus* (R. POT.) TH. & PF. may also appear in young Tertiary layers, this pollen is known in Hungary to be present in determinative quantities only in the Lower Eocene strata of the coal-basin of Dorog. As this pollen was represented by the greatest number of specimens, it must have undoubtedly come from a nearby situated palm-tree wood. The location of the investigated sample being a place relatively close to the coal-basin of Dorog, it is clear that the pollen of that plants fell into the limestone — the

place of their conservation — that formed the strata of the coal-field of the Lower Eocene of Dorog. It is not impossible, though I do not think it probable, that the observed spores and pollen may have come from that plants that contributed to the formation of the coal-streaks of Lábatlan. But if later investigations should prove this, the plants of the Lower Eocene of Lábatlan must have been identical with or at least similar to those of the Lower Eocene of Dorog. Further investigations will have to decide this question. It certainly is interesting to observe that besides the majority of Palm pollen there is also a significant quantity of *Taxodiaceae-Cupressaceae* pollen present. This supports the point of view about the zonation of plants I have indicated in a former paper (5).

If the questions mentioned in the opening lines have to be answered, we have to take into consideration the following points:

1. The investigated sample is uncommonly deficient in pollen; but we can imagine the flora contributing to the Lower Eocene coal deposit of Dorog only as an exuberant subtropical or tropical vegetation, and species occurring in big quantities produce an abundance of pollen, as in general all anemophylous plants do; and the pollen are carried very far by the wind. (The problem is going to be still more complicated if further investigations should prove that the observed specimens are pollen of the vegetation that has contributed to the coal streaks of Lábatlan and had been similar to that of the Lower Eocene of Dorog.)

2. The pollen flora of the Lower Eocene of Halimba and Dudar is in every respect different from the pollen flora of Dorog.

3. The coal strata of Dudar and the coal beds of Dorog (district Nagysáp) are, as the geologic results show, both Lower Eocene (Sparnat) formations.

So, if the formation of the above mentioned coal-basins has really taken place at the same time, we can state that the aspect of the Hungarian flora in the Lower Tertiary was of considerably dissimilar character. Based on our present knowledge I propose to divide the Hungarian Lower Eocene floras into the following districts:

1. Flora district of Dorog (Nagysáp).

Note. — I separate this type on the basis of my investigations made in the district of Nagysáp in the coal region of Dorog. After a detailed palynological study of the basin the following characterization will presumably require completion.

Characteristic plants are the Palms. Though many forms could be successfully separated inside this category, the dominant tree is (based on the pollen) a uniform, with *M. tranquillus* (R. Pot.) Th. & Pf. corresponding type. In the littoral region the flora was zonal, due to the different ecologic conditions (5): open swamp, *Taxodiaceae-Cupressaceae* swamp wood, Palm grove, *Myricaceae* copse, a *Sequoia wood* on a higher level may be supposed.

2. Flora district of Halimba.

Based on the results of H. DEÁK (3), on her verbal communications, and on my own observations (7) the following characterization can be given:

Dominant forms are the *Cupuliferae* pollen, principally the pollen grains of the *Castanea* genus, which indicate a vegetation growing on a higher level. Besides this, on a lower level and under more moist conditions, a *Myricaceae* copse was situated. Significant is also the quantity of *Sapotaceae*. This territory

can be demarcated from the flora district of Dorog in the first place by the minimal quantity of *Palmae*, respectively, by the heterogenous character of the flora (7) caused by the various ecological conditions due to level differences.

3. Flora district of Dudar.

The results of our investigations are not yet sufficient to base on them the description of the territory, respectively, the paleobotanical characterization of the fossil flora. Nevertheless, we know enough to see that it is impossible to bring this territory, botanically, in connection with the flora district of Dorog. But just because of the insufficiency of our knowledge we cannot perfectly make clear its relation to the flora district of Halimba, though a certain resemblance between the two is obvious. I do not think it impossible that it will be practicable to unite these two flora districts after further investigations under the name „Floral district of the Bakony”, and then distinguish smaller units within this range. This attitude in the present state of our knowledge seems justified as the palynological conditions of the Lower Eocene strata of the Bakony are very complex. The relationship between the floral districts is illustrated by this sketch:

Flora district of Dorog (Nagysáp)

Flora district of Halimba

Flora district of Dudar

} ? Flora district of the Bakony

The geographical distribution is shown in outline in figure 1.

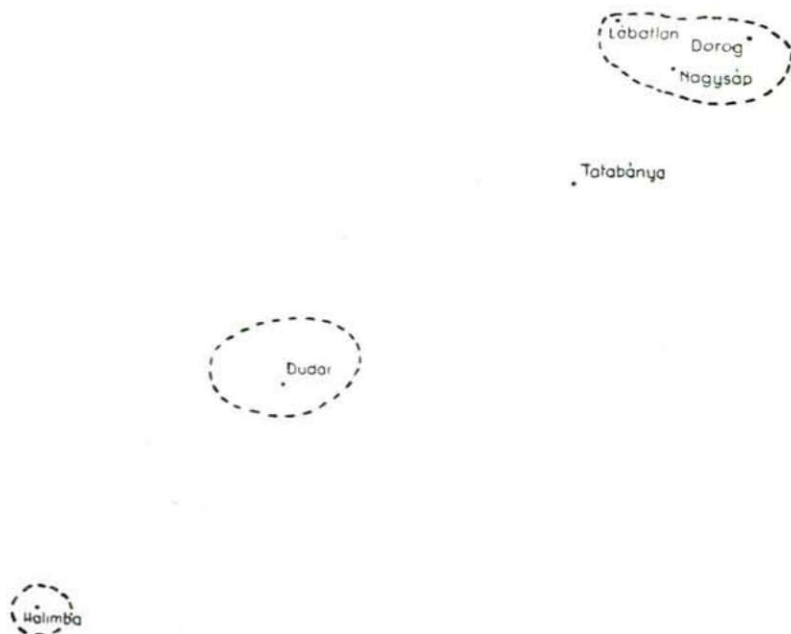


Fig. 1.

Distribution sketch of the Lower Eocene flora districts determinable up to now in Hungary

The thorough, detailed investigation of the Eocene strata of the Bakony mountains, of the palynology of the coal basin of Tatabánya, and of the coal streaks of Lábátlan will be very interesting and important for the reconstruction of the Hungarian Lower Eocene (Sparnat) flora.

The above mentioned different flora districts came into existence in consequence of different ecological conditions. Though our data are in this respect still insufficient, based on the statements of ANDREÁNSZKY (1) an attempt can be made to estimate the floral assemblages determined by palynological investigations on systematic basis. The dominant assemblages of the floral district of Halimba as well as those of the floral district of Dudar can be counted to the *Aestisilvae*, while the Lower Eocene flora of Dorog belongs rather to the *Durisilvae*. The latter statement is in agreement with ANDREÁNSZKY's opinion. It is also worth of attention that in the opinion of ANDREÁNSZKY (1) *Aestisilvae* are the more ancient, *Durisilvae* the younger, and between the two there exists a direct genetic connection. It cannot be left unsaid that if we take the stratigraphic table of THOMSON & PFLUG (14) as basis, the spores and pollen assemblage of Halimba can roughly be identified with the upper deposit of Helmstedt, and that of Dorog with the palynological features of Borken. Therefore, if later geological results should prove time differences between the Eocene strata of the discussed territories, a short phase of the evolution of the assemblages of plants could be followed up even on the ground of the up to now achieved palynological results. (*Aestisilvae* of Halimba are more ancient — THOMSON & PFLUG (14), *Durisilvae*, proved by the investigations in Dorog, are derived of them — ANDREÁNSZKY (1)).

Today many authors insist on it that working on stratigraphic pollen analysis one has to take the ecologic factors into consideration. So, e.g. the statements of VAKHRAMEEV & JAROSHENKO (17) are very valuable. But the results of KRÄUSEL (8) in connection with the ecological significance of the Tertiary local floras are also not to be neglected. On the basis of the book of VADÁSZ (16) it does not seem impossible that the Hungarian floras were to a certain extent of this type in the Lower Eocene. Based on my results, the plants that have contributed to the Lower Eocene coal strata of Dorog certainly indicate a flora of local character. VADÁSZ (16) says in his above mentioned book, „As more or less separated territories can be regarded: the Southern Bakony (Ajka—Urkut—Halimba), the Northern Bakony (Fehérvárcsurgó—Csérnye—Zirc—Bakonybél—Magyarpolány—Bakonyszentlászló) the north-eastern foreground of the Vértes Mountains (Tatabánya—Nagyegyháza), the southern bays of the Vértes Mountains (Csákberény—Gánt), the northern side of the Gerecse Mountains, the territory of Esztergom (Dorog—Tokod), the Budaer Mountains (Nagykovács—Pilisvörösvár—Pilisszentiván), the Nógráder block-mountains (Kósd—Nézsza), the Eocene of the south part of the Mátra-Mountains (Derecske—Recsk), and of the Bükk Mountains.” This enumeration demonstrates very well the important tasks the Hungarian Lower Eocene (Sparnat) palynology has to perform.

So the Hungarian floral districts belong, based on the book of VADÁSZ to the following parts: the floral district of Halimba to the Southern Bakony, the floral district of Dorog to the basin of Esztergom, while the floral district of Dudar can be counted to the basin of the Northern Ba-

kony. It seems logical to accept the names used in the special geologic literature, but based on our present data we cannot yet botanically separate the above mentioned parts of the basin, or rather, in the decisive majority of the above mentioned territories we did not even succeed up to now in determining the identity of the flora inside one individual part of the basin: so this is not yet appropriate. But it is sure that the geologic separation is the consequence of geographic and ecologic differences, which certainly could have originated different floras. The detailed reconstruction of the floras of the different territories will be of great interest and may perhaps furnish very valuable data to the phylogeny of the Hungarian Lower Eocene plant assemblages, establishing relationships between them.

Based on what already know, the Hungarian Lower Eocene flora was certainly very differentiated and ecologically of dissimilar character.

However, identical or similar floras have been originated on very distant territories in the same period by essentially similar ecological conditions. For example, the pollen flora of Dorog is related to the Eocene floras of North-america (private communication by letter from Prof. Dr. L. R. WILSON). The floral district of Halimba shows some connection with the assemblage described by TRAVERSE (15).

Identical ecological conditions produce an identical or at least very similar vegetation on quite distant territories, and this can be closely followed up by the results of palynological investigations; on the other hand, a change in the ecological conditions on a relatively small territory (so for instance in Hungary) brought forth a vegetation of very different character in the Lower Tertiary. Therefore, the question whether the Hungarian Lower Eocene strata, the formation of which has taken place at the same time, have the same or at least in the essential features identifiable pollen spectrum must be answered on the basis of our present knowledge with a definite no. This follows directly from the above statements. But it also agrees both with the opinion of ZAKLINSKAIA (18) and, essentially, with the opinion of KUYL, MULLER & WATERBOLK (10). As the results have shown, the characteristic pollen spectrum of Dorog is restricted to a very limited territory. So there is no other possibility but to solve the stratigraphic questions by a synthetical method. In the last instance the deciding factor in solving the stratigraphic problems has to be the reconstruction of the fossil floras and their ecological conditions.

Summary

1. The spores and pollen, found in the Lower Eocene (Sparnat) freshwater limestone of Lábatlan can be identified with the assemblage of the Lower Eocene coal strata of Dorog.

2. Based on the up to now achieved palynological investigations of the Lower Eocene three Hungarian Lower Eocene (Sparnat) floral district can be distinguished: 1. Dorog, 2. Halimba, 3. Duda.

3. The different character of Eocene floras of the same period, caused by different ecological conditions, supports the opinion that the palynological stratigraphy of the Tertiary cannot be solved without the reconstruction of the fossil floras and their ecological conditions.

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