

SOME CONSIDERATIONS ON LEAF SIZE CLASSES AND THEIR HISTOGRAMS

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Abstract: The paper presents a discussion on leaf size classes and their respective histograms. In the first part the author shows aspects that condition an interpretation more or less close to the reality of the fossil forest, in the second part he gives an analysis and interpretation of 14 histograms of fossil floras from different fossiliferous points. The author's most important conclusion is that a histogram of the leaf size classes presents, though even deformed, the material made available by the respective fossil forest.

Introduction

The issue of leaf size classes has been insufficiently studied, as concerns both the present-day leaves and, especially, the application to fossil leaves. Researchers [19,18,12] have been satisfied to present them, and their histograms, without any comment or conclusions. While the interpretation of the fossil leaf size classes histograms may offer us a sum of indications of which the most important are those concerning the way of transport and the aspect of the original forest. In this paper we shall try to explain several questions resulted exactly from the study of some fossil histograms as well as the matter of their interpretation.

Every histogram must be interpreted in view of a complex of factors. Firstly, we must underline that any histogram of a fossil flora refers to an allochthonous flora. We consider that only in exceptional situations we may assert that a fossil flora from a sedimentary deposit is native [10]. Being allochthonous implies transport, while this, in turn, implies a more or less thorough selection of the deposited material. Therefore we underline that the leaf material studied is selected, to a lesser or greater extent, and does not represent, but for the exceptional cases, the forest it comes from in its quasitotality. We will have to find a set of criteria according to which we shall appreciate the following: when a histogram is closer to the reality of the forest it comes from, in other words, reproduces it closer, we might say that the histogram is “very” or “acceptably credible”; and when a histogram is radically different from the reality it comes from, we might speak of an “improbable” histogram. There are at least two aspects of a histogram that we consider revealing and worthy to be taken into consideration in judging a histogram, namely, the percentage of microphyll types and the number of leaf classes that are present.

Yet, in judging a histogram, respectively, the degree of its plausibility, several other factors intervene, that are not usually taken into consideration: 1 – the quantity of collected material, 2 – the time of collection (both factors influence directly the number of the leaf classes present), 3 – the distance from the place where the forest had vegetated to the place of collection, and, of course, 4 – the place of sedimentation: in a sea basin, with waves or currents, or in a lake, finally, 5 – if the material had been transported by a smooth, slow water, or by an accidental freshet. All these can be inferred, more or less, from the study of the histogram, of the material, and, of course, from the geological conditions of sedimentation. Insofar as we resort to all these factors, we should come closer to the reality we are looking for: that of the tertiary forest.

We will underline the following observation which we consider to be of great importance. The influence of selectivity in the case of tertiary flora is an unquestionable matter, yet to a certain point, for, as concerns the leaf classes, this selectivity still preserves, on the

whole, the composition of the forest from which the respective leaves came from. Present-day studies have proved that the material of the contemporary forests is depositing with other leaf classes than those actually growing. We are not certain that we could overlap, without any restrictions, these studies and the situation of a tertiary forest. However many arguments may be evoked to explain the predominance of the microphyll class in a histogram [4,7,19], the explanation is simple: this class had been predominant in those forests. In agreement with the authors cited above, we will assert that irrespective of the factors involved, to which we shall add the floatage degree of the microphyll leaves, only the material supplied by that respective forest or forests can be sedimented in the deposit, and this material preserves, from case to case to a greater or a lesser extent, the composition of the original forest. A contemporary forest which has 4-12% microphyll and 56-80% notophyll leaves cannot fossilize but in the same proportion, and the microphyll leaves cannot achieve dominance [see 18, fig. 51, p. 145].

Discussions

Considering a number of 56 histograms of leaf size classes, according to Givulescu [10], Mai and Walther [19], Hably [12], Berger [3,4], Mouton [21,22] and Givulescu (this paper), and partially Mai [18], we ascertain that in 49 of them – respectively 87.5% - the microphyll class is predominant, while in the rest of 14.5% the nanophyll and, in a smaller degree, the notophyll classes are predominant. This observation is also an argument sustaining what was asserted above: the histogram reflects, more or less faithfully, the material offered by the respective forest.

In the following we will discuss the histograms presented in plates 1 and 2 only from the point of view of their credibility.

We may consider as belonging to the category of “improbable” the histograms of the floras from Meuselwitz (with 82% microphyll), from Divljana (78%), from Pichegru (76%), and, especially, the histogram of the flora from Keszötlz with 92%, this last one being a typical example of an “improbable” histogram. To this percentage of microphyll leaves 3 – 3-3 – 4 – 3 other classes are added, but their participation percentage does not exceed 10%, mentioning that the Keszötlz flora does not reach even 5%. We will note that the flora from Divljana [20] is deposited in marls in a relatively still environment, but it is quite fragmented, which presupposes a quiet, but long transport, with advanced selection. At Pichegru [25] the leaves are preserved either in sands (?) (we suppose sandy gritstone), in a seashore deposit, with the leaves disposed randomly, or they are fossilized in sandy clays, badly preserved here. The leaf material is strongly fragmented, as a result of a transport not necessarily long, but surely torrential, thoroughly selected on the way and selected continuously in the respective sea basin. The flora from Keszötlz [12] is, in its turn, strongly fragmented. We can assert that it is the result of a torrential transport with a thorough selection. We can not give any information about the flora from Meuselwitz [19], except that it represents the result of a river transport, which, although quiet, managed to select thoroughly the initial leaf material.

We shall underline once again, in conclusion, as a characteristic of the “improbable” histograms, the great percentage discrepancy between the few components, with an exaggerated predominance of the microphyll class. This is due to thorough selections, and the histograms do not represent, not even partially, the composition of the initial forest.

The histogram of the floras that can be named “very credible” are situated at the opposite side. We will include here the flora from Romankulsk [2], the histogram of which may be considered an example of a well-balanced histogram, with only 46.51% microphyll and 6 leaf-classes represented (lepto-macro). We will add that the plants appear to be exceptionally preserved, which supposes a short-distance transport with a quiet water course, and before all allows us to assume that this representation is very close to what had been the palaeogenous forest from the nearest proximity of the deposit. We include in this category the flora from

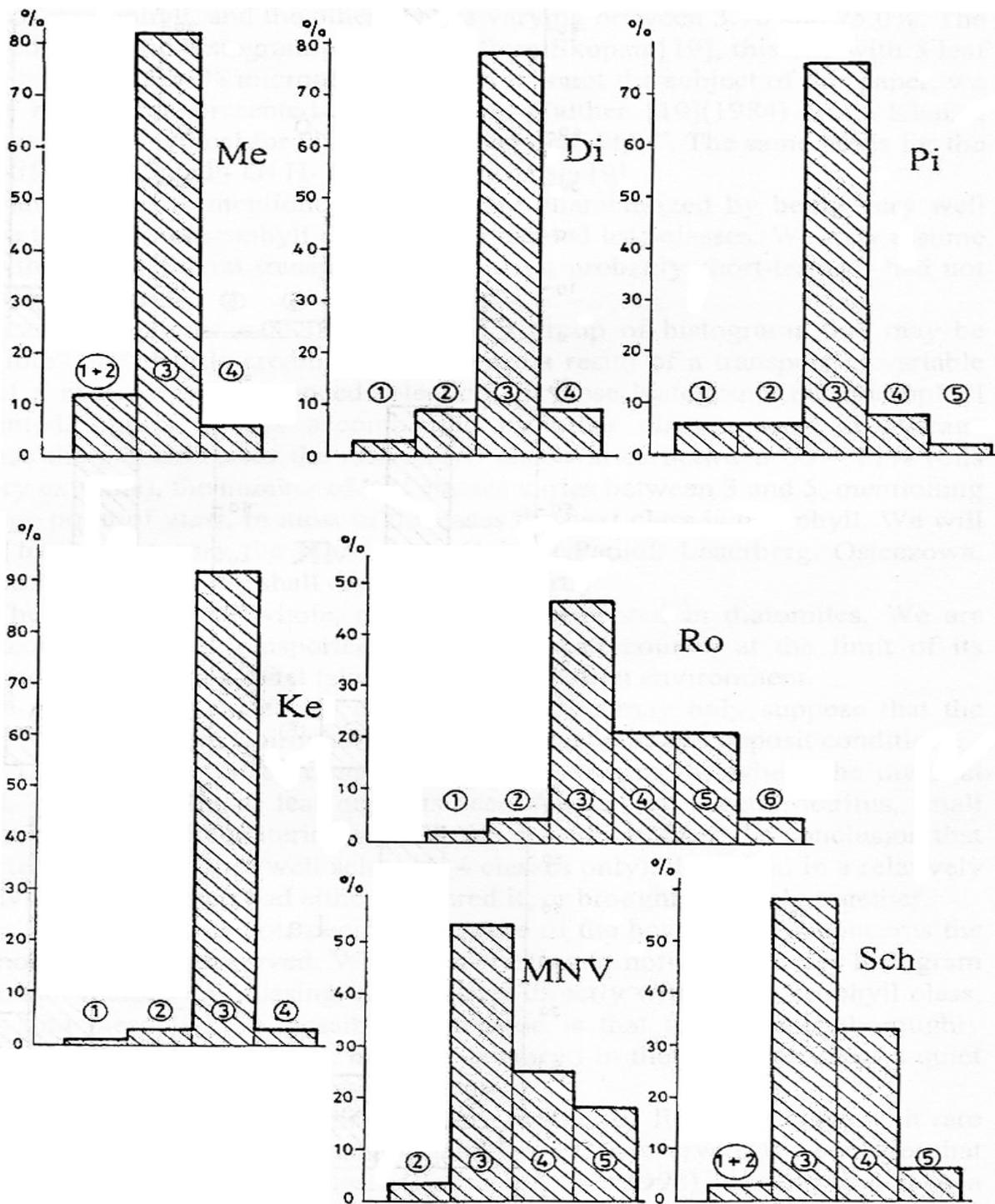


Plate 1: Me – Meuselwitz – late Eocene, Di – Divljana – late Oligocene, Pi – Picegru – Pliocene, Ke – Kesztole – late Oligocene, Ro – Romankulsk – Paleogene, MNV – Moravska Nova Ves – Pannonian “F”, Sch – Schkopau – middle Eocene

1 lept-, 2 nano-, 3 micro-, 4 noto-, 5 meso-, 6 macro-, 7 megaphyll-

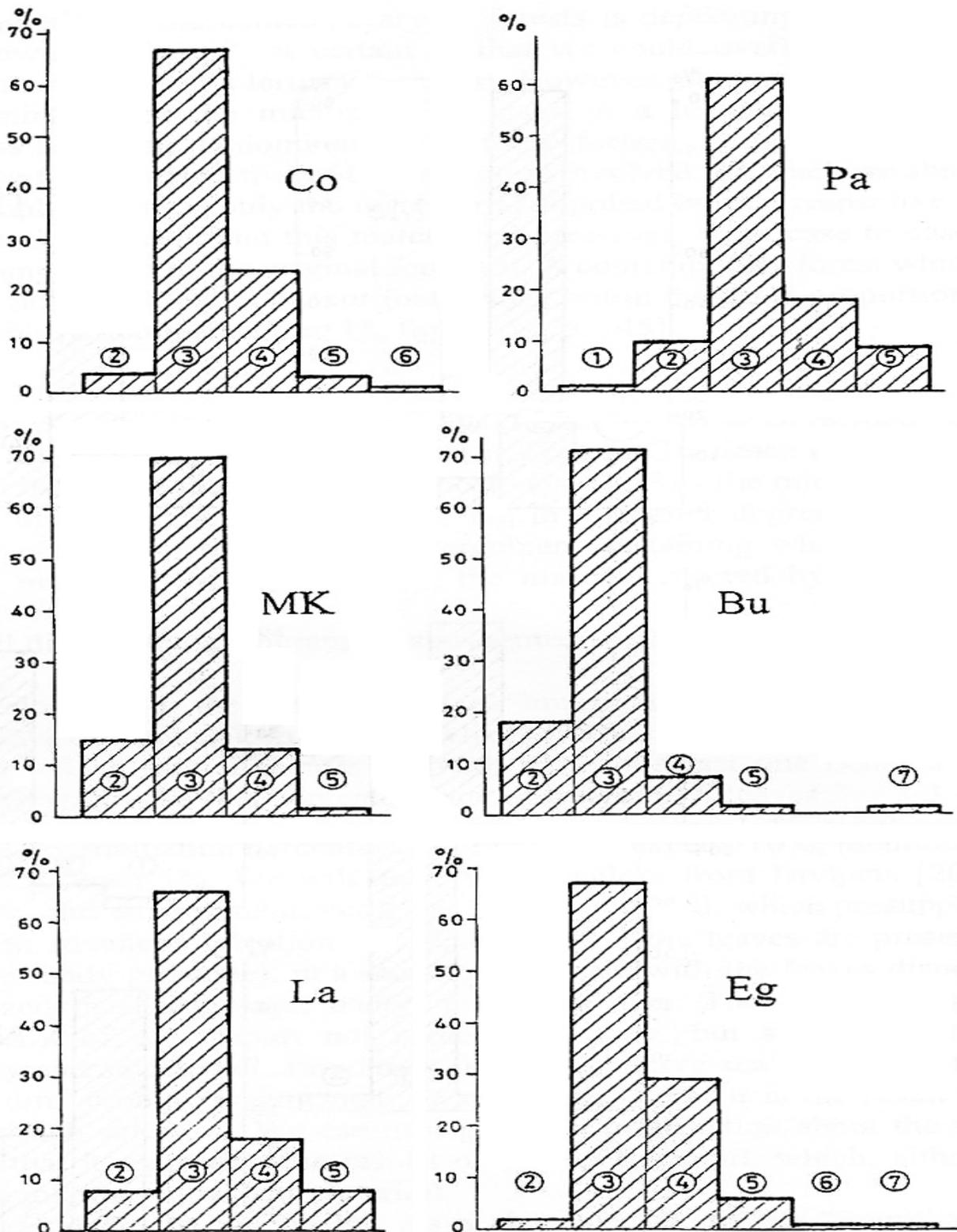


Plate 2: Co – Coiron – Pliocene, Pa – Papiol – Pliocene, MK – Mainz Kastel – Aquitanian, Bu – Bursuc – early Sarmatian, La – Laaerberg – Pannonian “E”, Eg – Eger – later Oligocene

1 lepto-, 2 nano-, 3 micro-, 4 noto-, 5 meso-, 6 macro-, 7 megaphill-

Moravska Nova-Ves [14] – a flora deposited in clays, well preserved and well represented numerically, sedimented under conditions of an unquestionable quietness, in the immediate vicinity of the place of vegetation. Its histogram is very well balanced, with only 4 classes (nano – meso), with 53.67% of microphyll, and the other classes varying between 3.76 and 25.0%. The same may be maintained about the histogram of the flora from Skopau [19], this one with 5 leaf classes (lepto – meso), and with 58.1% microphyll. Though it is not the subject of this paper, we will mention that the histograms presented by Mai and Walther [19](1984) from Klaus, Frohnsdorf, Knau are histograms typical for the category “very credible”. The same holds for the histograms of the fossiliferous points F- G- H- E₁- from Chiuzbaia [9].

All the histograms from the mentioned category are characterized by being very well balanced, with no more than 60% microphyll and well represented leaf-classes. We may assume that we are dealing with a quiet fluvial transport which, being probably short-termed, had not allowed the selection of size classes.

In between these two extreme categories there is a group of histograms that may be characterized as “credible” or “of little credibility”. They are a result of a transport of variable intensity, as well as of a more or less advanced selection. In these histograms the microphyll class is well represented, but is always accompanied by other classes, well or average represented. In this case the percentage of the microphyll class varies between 60 – 71% (this considered as a category extreme), the number of leaf classes varies between 3 and 5, mentioning that, from the percentage point of view, in most of the cases the next class is notophyll. We will consider as belonging to this category the floras from Coiron, Papiol, Laaerberg, Osieczowa, Eger, Mainz-Kastel, Bursuc, Gabbro. We shall discuss them shortly:

Coiron [11]. The leaves appear whole, only rarely fragmented in diatomites. We are dealing with little selected material, transported by a quiet watercourse, at the limit of its transportation power, and deposited in a quiet lakeshore sedimentation environment.

Papiol [8]. The authors do not specify the host rock. We may only suppose that the situation here is similar to the one from Coiron as concerns the transport and deposit conditions.

Laaerberg [5]. The host rock is represented by fossiliferous marls where the material appears either isolated, or in the form of leaf deposits accompanied by vegetal detritus, small branches. The preservation state of the material is good. We may draw, then, the conclusion that this is a water transported material, rather well selected (4 classes only), deposited in a relatively less agitated marine environment, which had either scattered it, or brought it closely together.

Osieczow [24]. The author does not specify the nature of the host rock. As concerns the big leaves, they are whole and well-preserved. What is interesting to notice about this histogram is that the lepto- and nano- classes are missing, and it starts directly with the microphyll class, followed by the noto- and mesophyll. A possible conclusion is that this flora is thoroughly selected as concerns the small classes (plate 3), but well-balanced in the rest, a result of a quiet transport and sedimentation in a similarly quiet environment.

Eger [1,17]. This is a marine or a marine salmastre deposit of fine grey clays with rare sand insertions. The plants are present in great number and are well preserved. We consider that this situation is similar to the one from Cornești (Petrescu et al. 1998), namely that it is a transport of a very rich material by a watercourse at the limit of its transportation power and deposited in a quiet gulf of the oligocene sea. A rather weak selection was done both by transport and by sedimentation.

Mainz-Kastel [16]. The extremely numerous plants appear preserved in a 10 cm layer of colloidal origin, in a perfectly still environment. Kräusel considers that they were brought by the wind, which may be possible only for the winged fruits. The perfect preservation state of the vegetal remains suggests a limited transport and a sedimentation in a perfectly still environment, with no waves, with a minimal selection.

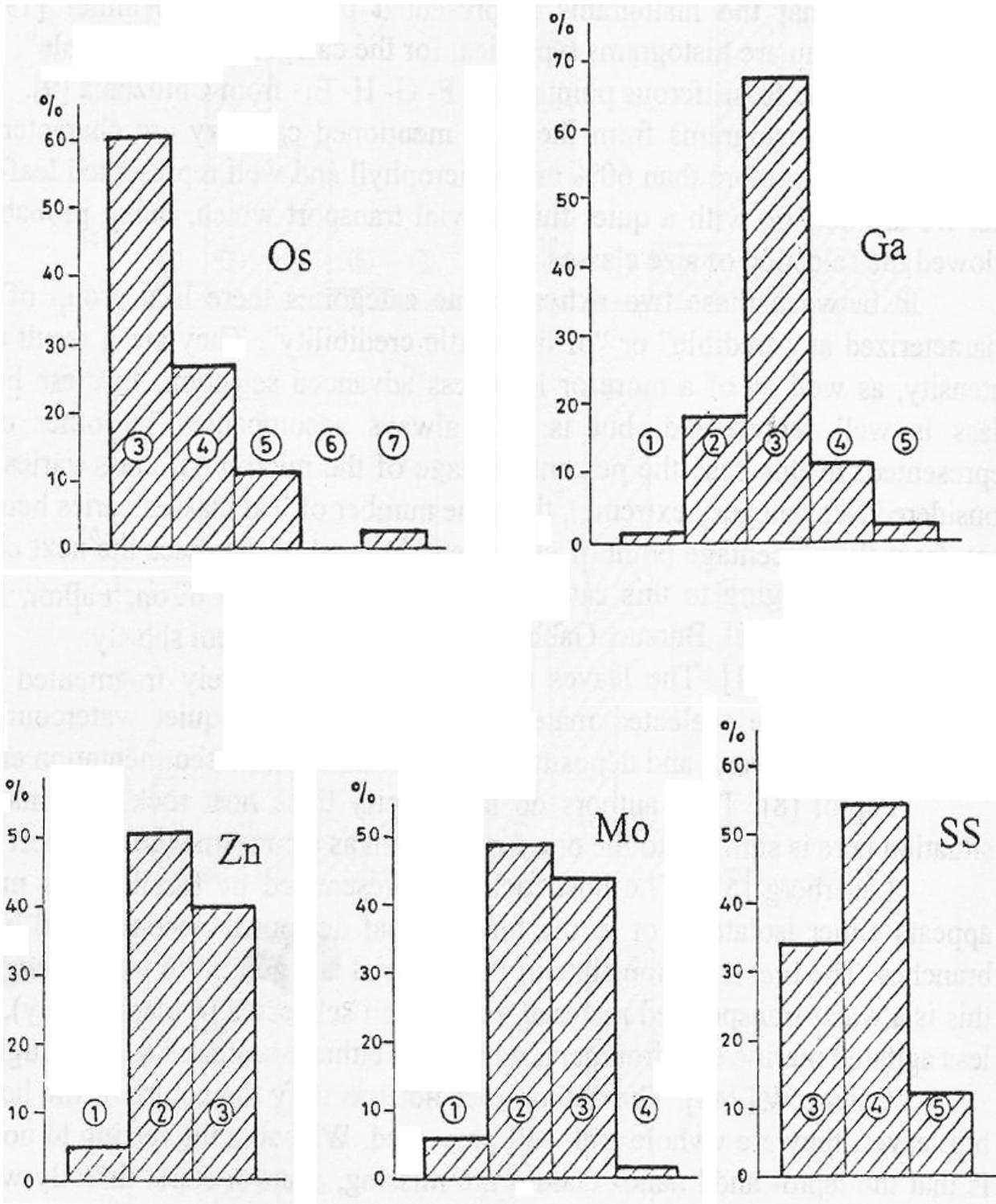


Plate 3: Os – Osieczowa – Mio-Pliocene, Ga – Gabbro – Messinian, Zn – Znoimo – Karpatien, Mo – Montjuic – Badenien, SS – Stare Sedlo – middle Eocene

1 lepto-, 2 nano-, 3 micro-, 4 noto-, 5 meso-, 6 macro-, 7 megaphyllite

Bursuc [26]. The plants are sedimented in marine clays, in layers with *Cystosteirites partschi* and marine – salmastre molluscs. The material appears here and there in the rock, but is well preserved. This seems to be a deeper beach deposit more or less selected by running water and rather little scattered by waves.

Gabbro [6]. The leaf material is preserved on fine marny limestones in layers and on finely stratified disodilic shales. It is very well preserved. According to Berger it is a seaside deposit, and the leaf material had been brought by rivers. We will add that the material is little selected, (5 classes!), a result of a very quiet transport, deposited in an isolated lagoon close to the respective sea shore.

We have 3 histograms left, namely those of the floras from Montjuic [27], from Znoimo and Stare Sedlo [14], that do not integrate into the normal type of the histograms discussed above, with maximum microphyll. In the first two the nanophyll class is predominant with 49, respectively 51%, followed closely by the microphyll. In the third histogram, the notophyll class reaches 54%, exceeding the microphyll class that hardly has 45%. With the exception of the histogram from Montjuic which has 4 classes, the other two have only 3 leaf classes. The flora from Montjuic appears in green clays and is well-preserved, sign of a quiet transport from a small distance to a still marine deposit, whereas the flora from Znoimo is preserved in clays and tuffitic clays, accumulated in thin layers in small depressions of the cristaline foundation. It is obviously an accidental torrential deposit that had not, though, altered or fragmented the leaves. In turn, we have no data concerning the deposit from Stare Sedlo. In the introduction we gave an explanation of this apparent anomaly, which we repeat here: irrespectively of the selectivity, the deposit contains only the material supplied by the respective forest.

In conclusion, we consider that by the histograms presented and explanations given we made one more step towards deciphering the tertiary forests and the transport and sedimentation conditions of the foliar material supplied.

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CÂTEVA CONSIDERAȚII ASUPRA CLASELOR DE MĂRIMI FOLIARE ȘI A HISTOGRAMELOR RESPECTIVE

(Rezumat)

Autorul se ocupă în prima parte a lucrării de observațiile ce trebuie realizate în cazul colectării unei flore fosile, respectiv, un număr cât mai mare de resturi vegetale, timpul cât a fost exploatat zăcămintul, distanța de la presupusul țărniș la locul de sedimentare, locul de sedimentare - lacustru, marin etc, modul de transport al materialului. Studiul a numeroase flore fosile și a histogramelor respective - este vorba de 56 flore - duce la concluzia că cea mai frecventă clasă de mărime este cea a microfilelor, urmată de cea a notofilelor. Autorul trage deci concluzia că pădurile terțiarului erau compuse în primul rând din frunze aparținând clasei de microfile. Aceasta pentru că nu se poate imagina ca prin sedimentare să se schimbe radical tipul de mărime de clasă foliară. Autorul studiază un număr de histogramme ale unor flore terțiare pe care le subdivide în histogramme improbabile - care nu reflectă realitatea pădurii, h. credibile sau puțin credibile și h. foarte credibile. Toate acestea în funcție de procentajul de microfile și de numărul și procentajul celorlalte clase de mărime de frunze. Concluzia finală este că există flore fosile ce reflectă compoziția pădurii din care provin, tot așa cum la polul opus există flore ce se îndepărtează total de compoziția pădurii din care provin și că aceste histogramme ne ajută să lămurim tocmai această problemă importantă a unui studiu paleobotanic.