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ON PROBLEMS OF MODERN PALYNOLOGY

E. D. ZAKLINSKAJA
Geological Institute of the USSR Academy of Sciences, Moscow, U.S.S.R.

ABSTRACT

Application of palynological data with the objective of reconstruction of paleoflora, the stratigraphy and correlation demands a single methodology during preparation of initial material (the most complete palynocomplexes). It is recommended to look through slides from one macerate and to pay attention not to the number of counted grains but to a number of established palynological species. It is established that the most valid for correlation are the species which are found in the study of numerous slides not being merely predominant in the palynoflora.

Key-words — Palynology, Stratigraphy, Methodology, U.S.S.R.

सारांश

आधुनिक परागाणुविज्ञान की समस्यायें – ई० डी० ज़ाक्लिन्सकाया

पुरावनस्पतिजात के पुनर्निर्माण, स्तरविन्यास एवं सहसंबंधन के उद्देश्य से प्रारंभिक सामग्री (अति सम्पन्न परागाणविक-सम्मिश्र) तैयार करने में एक ही विधि के प्रयोग की आवश्यकता है। एक मैसीरेट से बनी स्लाइड़ों के परीक्षण तथा गिने हुए परागाणुओं की संख्या के बजाय स्थापित परागाणविक जातियों की संख्या पर विशेष ध्यान देना अभिस्तावित किया गया है। यह निश्चित्त किया गया है कि सहसंबंधन हेतु मान्यतम् वह जातियाँ हैं जो कि अनेक स्लाइड़ों में पाई जाती हैं, न कि जिनका केवल परागाणविक-वनस्पतिजात में बाहुल्य हो।

INTRODUCTION

THE problems solved by palynological data are rather significant and cover a broad aspect, connected with evolution, stratigraphy, correlation of heterofacies deposits, effect of tectonical processes on sedimentation environments and history of continents and oceans.

Methods of palynological data application differ from the various types of problems. Some cases require application of statistic means, based on quantitative relations. In some other cases, quantitative relations are secondary, while qualitative parameters are gaining in importance for interpretation of palynological material.

It is of interest that together with extremely intensive development of palynology in a complex of sciences on the earth, the methodological background of spore-pollen analysis itself and interpretation of data, obtained with its help, occupy modest place.

I do not wish to say that the standardization of methods for preparation of primary, initial palynological material, its interpretation considerably determining a solution of the problem concerned, should be fixed once and for all. However, a single plan, single system is undoubtedly necessary. Otherwise the application of mass material for broad generalization is not reliable. (Zaklinskaja, 1977a).

Only a few palynologists do not introduce correction factor, resulted from relative analysis of composition of "pollen rain", productive associations and subfossil spectra, during interpretation of the data from young deposits (Pliocene-Pleistocene). Meanwhile, the works by many scientists (Grichuk, 1973; Koreneva, 1973; Vronsky, 1973; Klopotovskaya, 1973; Kabailene, 1973) show that how much care should be taken during reconstruction of former vegetation in coenocytic aspect on the basis of a spore-pollen analysis. The works on vegetation reconstruction contain only a few references

on methodological works of palynologists, convincingly indicating that a conversion from a spore-pollen spectrum to a composition of productive associations requires an introduction of numerous correction factors. Really, how is it possible to compare and to apply data, obtained in one case — during definition of 25 specimens of pollen and spores, and in another — 250 ones, for description of vegetation data ? Or is it possible to generalize palynological material, resulted from study of heterofacies deposits, without introduction of a corresponding correction ?

Establishment of vegetation cover type (steppe, forest, desert, tundra, etc.) is therefore the most accessible (in Pliocene-Pleistocene palynology) and reliable method. Therefore, establishment of such gradations needs quantitative parameters, while placing of such type of vegetative cover to a floristic region or its province demands quantitative analysis, based on the study of systematic composition of the established palynological taxa.

The problems on methods of preparation of initial palynological material (complexes of spores & pollen) for its interpretation during biostratigraphical studies are represented in the literature inadequately. It is well known that the taxa, which had died out by now, were established in the flora of the Paleogene (the Early & Late Cretaceous and more earlier stages) while the pollen and spores of the plants, whose systematic position can be synchronized with recent flora in rank of a family or even a genus, did not necessarily have the same ecological parameters, not to mention the areas with recent flora.

Therefore, reconstructing of biogenetic flora and searching for valid taxa (and their groups) for substantiation of a correlation or stratigraphy demand special means both for obtaining initial data and their interpretation.

Unfortunately, all these problems received unduly insufficient attention, and therefore, palynological data, often very interesting, are interpreted with considerable errors without taking into account "resolving power" of palynological methods in each separate case.

The problem and complex validation of regional, inter-regional and global correlation, connected with the general task of putting in relation to the international stratigraphic scale, is the most acute now-a-days. The significance of palynological study in this respect is great, if even because that the direct correlation between marine and continental deposits is possible only with the help of palynological data. Faunistic methods are useless. In this respect, the preparation and selection of initial material should be necessarily "transformed to a general index".

Pre-Pleistocene and even Pre-Neogene palynology which has at its disposal palynological complexes with such components, as in most cases, cannot be correlated with those of recent associations and therefore no phytogeographical and phytocoenological reconstructions can be arrived at. At the same time, the floristic features, evolutionary boundaries, differentiation of flora, stages and phases of development are well fixed by palynological data. Therefore, the establishment of the most complete systematic palynocomplexes demands a single methodology.

It is well known that palynological monuments far from completeness reflect the life composition of fauna and flora. Only small proportion of a complete amount of taxa, composting flora at each stage of the region concerned, will find its reflection in the palynological complexes, despite a pollen and spore ability to be transported at considerable distances from productive ceonoses. Therefore, investigation of each sample in the sequence of marine and continental deposits should not be limited by examination of given number of slides or specimens of fossil spores and pollen. During investigation of the other slides the study of each sample can be terminated only when the palynological species found earlier will disappear. It is quite possible that the palynologists during the study will spend some time for an observation of several dozens of slides and for shooting and fixing of several hundred specimens of fossil pollen and spores (Table 1).

The thing is that the "pollen rain", being mixed complex of spores and pollen with different dispersion areas (distribution), includes components with such concentration centers, which lie at different distances from the place of their burial. It is quite possible (as happens in majority of cases)

TABLE 1

Species	Number of slides														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. *Leiotriletes* sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2. *Leiotriletes adriensis* W. Kr.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3. *Matoniasporites* sp.	+	—	—	+	—	—	+	—	+	+	—	+	—	—	—
4. *Concavisporites* sp.	+	—	—	—	+	—	+	—	—	—	+	+	—	—	+
5. *Undulatisporites interreticulatus* Cherniavska	—	—	+	—	—	+	—	+	—	—	+	—	—	—	—
6. *Toriosporites postregularis* W. Kr.	—	—	—	+	—	—	+	—	+	—	—	—	—	—	—
7. *Gleichenia senonicus* Ross	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
8. *Reticulatosporites* sp.	+	—	+	+	—	—	+	+	—	+	—	—	—	+	—
9. *Leptolepidites* aff. *ballatus* (Hoeken-Klinkenberg) Srivastava	—	—	—	—	+	—	—	—	+	—	—	+	—	—	—
10. *Leptolepidites* sp.	—	—	—	+	—	—	—	—	+	—	—	—	—	—	—
11. *Osmundacidites* sp.	—	—	+	+	—	—	+	—	—	+	—	—	+	—	—
12. *Nevesisporites radiatus* (Chlon.) Srivastava	+	—	—	—	—	—	—	+	—	—	—	—	—	—	+
13. *Vadosisporites pseudoporatus* sp. nov.	—	—	+	—	+	—	—	—	—	—	—	—	—	—	—
14. *Polypodiaceoisporites haemussensis* Cherniavska	+	+	+	+	+	+	+	+	+	—	—	—	+	—	—
15. *Retitriletes vanustus* Frederixen	+	—	+	—	—	—	+	—	+	—	—	—	—	+	—
16. *Appendicisporites* sp.	—	—	+	—	+	—	—	+	—	—	—	—	—	—	+
17. *Polypodiaceoisporites* sp. 1	—	—	+	—	—	—	—	—	—	—	—	—	+	—	—
18. *Polypodiaceoisporites* sp. 2	+	+	+	+	—	—	+	—	+	—	—	—	—	—	—
19. *Polypodiaceoisporites* sp. 3	—	—	—	—	—	+	—	—	—	—	+	—	—	—	—
20. *Liliacidites* sp.	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—
21. aff. *Myrica* sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—
22. Palmae (gen. et sp.)	—	—	—	—	—	—	—	—	+	—	—	+	—	—	—
23. Pandanaceae (gen. et sp.)	+	+	+	+	—	—	—	—	—	+	—	—	—	+	—
24. aff. *Arecipites*	—	—	+	—	—	+	—	—	—	—	—	—	—	+	—
25. *Pompeckjioidaepollenites* sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
26. *P. subhercinicus* (W. Kr.) W. Kr.	—	—	+	—	—	+	—	—	—	—	—	+	+	—	+
27. *Plicatopollis* sp. 1	—	—	+	—	—	—	+	+	+	+	—	—	—	—	+
28. *Pseudoplicatopollis vestibulatus* sp. nov.	—	—	—	—	—	+	—	—	—	—	—	+	—	—	—
29. *Pecakipollis verrucosus* Pacet. et W. Kr.	—	—	—	—	—	—	+	+	—	—	—	+	—	—	—
30. *Plicatopollis* sp.	+	+	+	+	+	—	—	—	+	—	—	+	—	—	—
31. *Nudopollis* sp.	+	—	—	—	—	+	+	—	—	—	—	—	+	+	+
32. *Nudopollis minutus* Zakl.	—	—	—	+	—	—	—	—	+	—	—	—	—	—	—
33. *Ulmoideipites* sp.	—	—	—	—	—	+	—	—	—	—	—	+	+	+	—
34. Sapotaceae (gen. et sp.)	—	—	+	—	—	—	+	+	+	—	—	+	—	—	—
35. *Tricolporopollenites* Pacl t.	—	—	—	—	—	—	—	—	+	+	—	—	—	—	—
36. *Extratriporopollenites fractus* Pfl.	—	—	—	—	+	—	—	—	—	—	—	—	—	+	—
37. *Trudopollis pertrudens* Pfl.	—	—	—	+	—	—	—	—	+	—	—	—	—	—	—
38. *Thomsonipollis expositis* Tschudy	—	+	—	—	—	—	—	—	—	—	—	+	—	—	—
39. *Thomsonipollis magnificus* (Th. et Pfl.) W. Kr.	+	—	—	—	—	—	+	—	—	—	—	—	—	+	—
40. aff. *Fagus*	—	—	—	—	—	—	+	—	—	—	—	—	+	—	+
41. *Triatriopollenites confusus* Zakl.	+	—	—	—	—	—	—	+	+	+	—	—	—	—	+
42. *Retitricolpites* sp.	—	—	+	—	—	—	—	—	—	—	—	+	—	—	+
43. *Engelhardtia* sp.	—	—	—	—	—	+	—	—	—	—	—	—	—	+	—
44. *Concavipollis* sp.	—	—	—	—	+	—	—	—	+	—	—	—	—	—	+
45. *Interpollis supplingensis* W. Kr.	—	—	—	—	—	—	+	—	—	—	—	+	+	+	+
Species on one slide	17	10	22	16	13	14	20	14	21	12	8	18	14	14	16
New sp. on one slide	17	1	11	4	3	4	3	—	2	—	—	—	—	—	—
Species from the previous slides		9	11	12	10	10	17	14	19	12	8	18	14	14	16

Example of establishing of the most complete palynocomplex by means of one sample (Early Paleogene marine deposits, the South Ukraine). It shows a number of fossil pollen and spores, discovered during study of palynoflora in 15 slides of one mecerate. Total number of pollen and spore grains = 325. Total number of species = 45.

that the species, describing flora of the province concerned, lived and entered into the association far remoted from the place of studied sediment formation. Naturally, the probability of finding of such species among predominant (however, without correlative significance) taxa will be very small and while studying a limited number of slides, they will not be simply discovered.

It was established that the so-called key (used for intercontinental correlation) and the so-called correlative (used for inter-regional correlation) palynological taxa belonged to the species (or genera) of plants with a short life span and extremely broad (sometimes broken). The first — key ones — were distinguished by such areals, which extended over the boundaries of paleofloristic province (eg. the species *Complexiopollis*, *Thomsonipollis*, *Nudopollis*, *Aquilapollenites*, *Mancicorpus*, *Ulmoideipites*, *Triatriopollenites confusus*, *Plicapollis*, *Pseudoculapollis*, *Turonipollis*, *Interpollis*, *Tricolpites*, *Tricolporoidites*, etc.). The second-correlative ones had areals, which extended over the boundaries of paleofloristic areas and provinces (e.g. the species *Stephanoporopollenites*, *Revesia*, *Extratriporopollenites*, *Wodehouseia*, *Azonia*, *Betpacdalina*, *Pentapollenites*, etc.). So-called the typical taxa of plants, spores and pollen, which are applied for regional and local correlations had areals within the boundaries of floristic areas and provinces. Usually, they are predominant in the complexes; however, they may be present as a single sporadical find depending on sedimentation environments of the rock concerned. Therefore in these cases, when the palynological study was made for validation of the local correlation, the palynologist nevertheless has no right to stop the investigation of the sample till disappearance of the species observed earlier. Thus, the established and most complete systematic list of fossil species of pollen and spores is regarded as a initial primary material for drawing further conclusions.

The methods of obtaining of initial palynological material for further floristic analysis have been applied for many years by the Laboratory of Cenophytic Palynology of Geological Institute of the USSR Academy of Sciences, and only these methods enabled during study on the early and middle Cenophytic flora, to establish the floristic differentiation of the Early Cretaceous — Early Paleogene, stages and phases in development of flora in the eastern and western parts of the northern hemisphere, nature of 7 times change of seven groups of phylogenetically single level of flora; stratigraphic and correlative significance of key, correlative and typical taxa; palynochrones, describing stages in development of the Cenophytic flora and the palynoflora representing them with palynocomplexes defining their beginning, middle and end; the series of palynocomplexes (PK) containing valid palynological taxa for correlation with different scales.

Only these methods permitted to establish correlative palynocomplexes, not only in continental (usually rich in pollen & spores) deposits but in near-shore, flysch, tufogene and metamorphosed rocks, comprising unbroken, lithologically variegated series of sediments.

Only these methods give an opportunity to establish the key complexes of pollen and spores (Pk), which enable a correlation between marine and continental deposits within geochronological units of stage significance (rarely — more detailed). Such a correlation permits validating of relatively detailed subdivision of faunistically barren sediments while correlation between marine and continental deposits — defining a relation between the boundaries of the palynological scale (stages, phases, subphases) and subdivisions of geochronological taxa, established on the basis of different species of marine and continental fauna (Zaklinskaja, 1977a; Zaklinskaja & Lauchin, 1979; Sinopsis, 1979).

REFERENCES

GRICHUK, M. P., KOREVSKAYA, I. A., KARTASHOVA, G. C., MAHOVA, I. A. & MALAEVA, E. M. (1973). Pollen and spore composition in different present-day deposits of eastern Siberia and the Far East of the USSR. *Methodical Problems of Palynology*, "*Nauka*": 77-81.

KABAILIENE, M. V. (1973). On the information of pollen spectra and the reconstruction of vege-

tation. *Methodical Problems of Palynology*, " *Nauka* ": 16-19.

KLOPOTOVSKAYA, N. B. (1973). The principal regularities in the formation of subrecent spore and pollen spectra of continental deposits of western Caucasus. *Methodical Problems of Palynology*, " *Nauka* ": 107-113.

KORENEVA, E. V. (1973). Distribution of pollen and spores in marine and oceanic sediments. *Palynology — Holocene and Marine Palynology*, " *Nauka* ": 111-114.

SYNOPSIS: Key and correlative angiosperm pollen taxa (upper Creide-Paleogene). M., " *Nauka* ", 1979: 118.

VRONSKY, V. A. (1973). Palynological studies of bottom sediments of the sea of Azov. *Palynology — Holocene and Marine Palynology*, " *Nauka* ": 127-128.

ZAKLINSKAJA, E. D. (1977). Principes of the palynological correlation. *Methods of Interpretation of the Palynology Data, Leningrad*: 13-16.

ZAKLINSKAJA, E. D. Angiosperm from palynological data. *Development of the Mesozoik — Cainozoik Boundaries Flora*, " *Nauka* ": 66-119.

ZAKLINSKAJA, E. D. & LAUHIN, S. A. (1979). Correlation of North hemispherical Paleogene on the palynological data. *Itogi nauki i techniki, stratigr., paleontol.*, **10**: 1-96.