THE IMPACT OF PALYNOLOGY ON TAXONOMY

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SUMMARY

Homology and its relationship to taxonomic palynology is discussed and the potential contribution of palynology to taxonomy considered. The author argues that the integration of palynological data into taxonomy and the application of modern taxonomic concepts to the data is necessary if palynology is to assume an influential rôle in plant systematics

RESUMEN

Se tratan los temas de la homología en relación con la palinología taxonómica y se examina la contribución potencial de la palinología a la taxonomía. El autor sostiene que si la palinología debe jugar un influyente papel en la sistemática de plantas, es necesaria la integración de datos palinológicos en la taxonomía y la aplicación a estos datos de modernos conceptos taxonómicos.

INTRODUCTION

This brief paper is concerned with a simple but fundamental issue concerning taxonomic palynology that is rarely debated at conferences or considered in the literature. This is the issue of homology which lies at the heart of comparative biology.

I would like to emphasize why I think it is important for palynologists to think about such general issues. I began to study palynology about twenty years ago at a time when many university departments and other institutions were establishing new palynological laboratories. The main objective of these particular laboratories was to investigate the diversity of pollen grains and spores and apply the findings in plant taxonomy. These developments were stimulated by many factors. Important influences included Erdtman's taxonomically oriented

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palynological studies (ERDTMAN, 1952, 1957, 1965), the systematic application of transmission electron microscopy (for example by, SKVARLA & TURNER, 1966) and the development of the scanning electron microscopy. Around the world, such laboratories have contributed much valuable research. However, although we now know much more about the morphological diversity of pollen grains and spores than previously, it is my opinion that we palynologists have not influenced plant taxonomy as much as we should have done.

Some of the reasons why the taxonomic impact of palynology has been less than it could have been are easy to identify. Firstly, studies of pollen have not always been integrated with the results obtained from other kinds of characters. This makes it difficult for the reader to interpret the significance of the palynological study (BLACKMORE *et al.*, 1991). Secondly, modern taxonomic concepts and methods of character analysis have often not been used. Unfortunately, as a result, palynology has tended to be left behind while systematics in general has moved on. Two additional factors that tend to reduce the impact of palynology on systematics are the complex terminology of the subject (DAVIS & HEYWOOD, 1963) and the extreme complexity of circumscribing comparative characters based on pollen morpohology.

It might be argued that none of this matters very much, palynologists are contributing basic information of fundamental scientific importance and that the immediate impact of their findings is unimportant. However, we live in times when competition for the pool of funds available for science is increasing rather than decreasing. Taxonomic palynology could become a vulnerable subject in danger of being regarded as an optional extra unless it is fully integrated into plant systematics and seem to have a significant influence on it.

To achieve greater impact I believe that we palynologists must make use of concepts that are central to taxonomy, adopt modern methods of analysis and interpret our findings in a broad systematic framework.

THE CONCEPT OF HOMOLOGY

Taxonomy is a comparative discipline. We make comparisons between organisms in order to search for similarities and differences that reveal the relationships between them. This process requires the recognition of characters abstractions from nature, that form the basis of the comparison. These characters might equally well be drawn from pollen morphology, gross morphology, phytochemistry, cytology or other disciplines. An analysis of the occurence of the characters in the taxa under investigation is used to recognise natural, or monophyletic, groups.

An analytical procedure is essential because whilst any attribute of an organism can be a character, only some characters can define groups within a hierarchical system. It is possible to compare any attribute that varies between organisms, but not everything that varies has the ability or power to inform us about groups. Characters that define a group are known as homologies, or

synapomorphies (see, PATTERSON, 1982). Such characters are distinguished from plesiomorphies, which occur at a more inclusive level in the taxonomic hierarchy.

In this context, a group can be a taxon at any rank, it can be a species, a genus, a family or a kingdom. Every monophyletic group, at any level, must share some homologies that define it. The important question for taxonomists is to discover which characters (out of all those we might observe) are homologies that define monophyletic groups.

There have been many approaches to the recognition of groups. BLACKMORE & BARNES (1990) pointed out that cladistic methods were now strongly favoured in zoology and increasingly are the method of choice in botany. There are many general reviews of cladistic procedures and some recently published books include RIEPPEL (1988) and FOREY *et al.* (1992). In outline the sequential procedure involves recognising characters, scoring their occurence in the taxa under study and performing an analysis of the distribution of characters. This analysis seeks to find the most parsimonius distribution of characters, with the greatest congruence between characters. After the analysis has been performed, character congruence (agreement with other characters) is taken to indicate a common origin in contrast to incongruence which indicates the condition of homoplasy. Homoplasy is misleading similarity, resemblance that can arise for a variety of reasons including parallelism, convergence or evolutionary reversals. The addition of new information (new characters on new taxa) may change the hypothesis of relationships, but in a well supported case additional characters will often be congruent and additional support.

DISCUSSION

Palynological studies often provide only a small number of characters, but if these form well supported groups they can be extremely important consequently palynology is potentially as important as any other source of characters and is not a separate discipline but rather, a specialised part of plant taxonomy.

Palynological characters can be analysed separately from the gross morphologhical information (see for example, BLACKMORE, 1982) and this provides explicit information about the ability of the pollen characters to define groups. A more satisfying approach involves the simultaneous analysis of pollen characters and other characters in a combined data matrix (see for example, BLACKMORE *et al.,* 1991; SCOTLAND, 1991; DOYLE & HOTTON, 1991). Probably the greatest challenge facing taxonomic palynologists is how to abstract characters from the great morphological variation that exists in pollen grains and spores. At present it is difficult to know how to characterise the fine levels of variation that frequently occur in ornamentation when studied in the scanning electron microscope. The potential to analyse this variation exists, but the conceptual basis on which caracters can be proposed is still poorly developed. However, this challenge is not peculiar to palynology, it faces all of taxonomy.

The delimitation of circumscription of characters is always the limiting factor on the quality of a taxonomic analysis.

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