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The most abundant fossil remains of terrestrial communities are the walls of pollen and spores of vascular plants. Quaternary mud and peat and sedimentary rocks as old as the Silurian commonly contain tens of thousands per cubic centimeter. While this abundance lends itself to the reconstruction of past floras and communities, the microfossils of extant genera and species are largely limited to Cenozoic strata.

Detailed and accurate fossil identification requires reference collections of hundreds of species and a key to aid in making comparisons with the fossils. Until the publication of Kapp's illustrated key,¹ North Americans have had to use keys to the northern European pollen flora. HOW TO KNOW THE POLLEN AND SPORES not only identifies over 300 pollens and spores of vascular plant taxa but also the spores of 39 fungi and 11 mosses. Although it can be used for the identification of atmospheric pollen and spores it emphasizes fossil identification. It includes 11 spore types of extinct plants and 15 algae and protozoan fossils. Each pollen and spore taxon in the key is carefully illustrated with drawings of either equatorial or polar views or both, and the cross-section and the surface of the wall are shown. Family name and geographic range are given for each species. The introductory chapters include brief discussions of pollen and spore formation and function, morphology, and field and laboratory procedures. No mention is made of recent advances in absolute pollen frequency techniques. The otherwise substantial bibliography omits references to the 1965 INQUA publications on pollen analysis and vegetation history. A useful systematic index is included as well as an index-glossary partly illustrated with scanning electron micrographs.

The morphological nomenclature closely follows Faegri and Iversen's TEXTBOOK OF POLLEN ANALYSIS (1964). The *lophate-fenestrate* group could have been more easily included with the *pericolpate* and *tricolporate* groups.

Inevitably such a key reflects the range and quality of a reference collection. Caution is necessary in using Kapp's size measurements. I suspect he used glycerine jelly mounts, and although he refers to Cushing's work on the swelling action of glycerine jelly media he does not discuss this in the text. My silicone oil mounted slides of *Populus* and *Abies* will not "key out" because they are too small. Examples of my size measurements in microns compared with Kapp's in parentheses are: *Abies balsamea* (body) 62-70 (80), *Populus deltoides* 24-26 (45), *Quercus velutina* 24-30 (40-45), *Fraxinus americana* 22-24 (38-41). However, most other taxa have similar measurements in our respective collections. Some of the pollen analyst's favorite fossil types are missing; mine include *Isoetes* microspores, *Sanguisorba canadensis*, *Selaginella selaginoides*, *Shepherdia argentea*, and *Acer rubrum*.

Despite its shortcomings this inexpensive book can serve as an introductory text. It certainly belongs beside the palynologist's microscope to show the way to a reference slide or bridge a gap in a slide collection.

ASPECTS OF PALYNOLOGY² largely concerns the evolution and stratigraphy of pre-Quaternary pollen, spores and other acid insoluble microfossils that are identifiable mostly to form genera or organ genera. Fifteen authorities have written 18 chapters, each with an average of 73 references. The first seven chapters discuss the principles and applications of paleopalynology including systematic occurrence in the plant kingdom, wall structure

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and composition, nomenclature, sedimentation, sample reliability and applications. The fact that most pollen and spores are initially released into the atmosphere is virtually ignored in the chapter on sedimentation. Also missed are the studies of modern marine sediment by Traverse and Cross. In the paleoecology section of the chapter on applied palynology no references are given to the many studies that correlate vegetation with pollen in surface samples. A chapter could well have been included on the applications of scanning electron microscopy.

A short and lonely chapter is devoted to classical macrofossil paleobotany, and another discusses dinoflagellate cysts and other miscellaneous objects that occur in palynological preparations.

Nine chapters discuss the evolution, stratigraphy and areal distribution of palynomorphs through geological time beginning with the algae, protozoa, and bacteria of pre-Cambrian rocks. Spores of vascular plants first appear in the lower Silurian about 440 million years ago. In the Devonian a comparison of spore types with rock types suggests ecological adaptations to saline lagoons, freshwater lakes, floodplains and delta swamps. Several floristic regions are mapped for the Permian period and one of them corresponds with the distribution of Gondwana leaf floras. Angiosperm pollen appears in the mid-Cretaceous, but its stratigraphic occurrence and morphology contributes few insights into the evolution of the angiosperms. It is not until the early Cenozoic that angiosperm pollen can be confidently assigned to extant families and genera.

Fossil pollen of the late Cenozoic, the past 25 million years, is mostly comparable to pollen of living families and genera. Relatively little morphological evolution or extinction is apparent. Thus, inferences can be made on the origin and distribution of modern floras and vegetation types. Estella Leopold's chapter on Late Cenozoic Palynology excellently summarizes the time from the mid-Tertiary (Oligocene) through the last Quaternary glaciation and focuses on the extra-tropical floras of the northern hemisphere. For the Tertiary she discusses the progressive loss of floristic diversity and increased provincialism but also reviews the first appearance and progressive diversification of such families as the Compositae. In the Quaternary section she gives an up-to-date review of methods for both absolute pollen frequency and relative pollen frequency. Methods of climatic reconstruction are presented along with a summary of the floras and climatic fluctuations of the Quaternary.

This expensive book is well illustrated with good photographs that will be of great aid to Quaternary pollen analysts in identifying redeposited spores and pollen. However, it is largely for the specialist or for reference reading.

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² Tschudy, Robert H. & Richard A. Scott, editors. 1969. Aspects of palynology. Wiley-Interscience, New York. vii + 510 pp., illus. \$24.95.

¹ Kapp, Ronald O. 1969. How to know pollen and spores. Pictured Key Nature Series. Wm. C. Brown Company Publishers, Dubuque, Iowa. ix + 249 pp., illus. \$3.25.