PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Preface

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THE ROYAL SOCIETY

Preface

The nature of interrelationships between major classes of bryophytes and between embryophytes (bryophytes and tracheophytes) and green algae has long preoccupied evolutionary botanists. The fossil record has done little to resolve alternative scenarios based on comparative morphology and cytology, although inferences from spore polyads suggest that land vegetation of embryophytes, at a presumed bryophyte-grade, preceded that dominated by tracheophytes by some 30 million years. Recent cladistic analyses involving both molecular and morphological (sensu lato) evidence ('total evidence') have reinvigorated research. They demand development of new approaches, together with reappraisal of existing data as prerequisites for the critical analysis of character states in both fossils and extant plants, some of which is reported at this meeting. However, while the main thrust of such activity is phylogenetic, the diversification of basal embryophytes was also intimately related to one of the most important events in the history of planet Earth—the colonization of the land by plants. The early phases of terrestrialization had major repercussions for evolution of terrestrial ecosystems, with impacts on physical substrate (e.g. soil formation) and the atmosphere (e.g. CO_2 draw down), while the interrelationships of the earliest land plants with animals, microbes and fungi, both living and dead, have not yet been fully explored. It thus seemed opportune to bring together neobotanists, including biochemists, molecular biologists, bryologists, mycologists and palaeobotanists, to exchange information and to present a synthetic approach to resolving hypothesized relationships. Brett Mischler provided the overarching phylogenetic framework based on 'total evidence' that had been produced by coordination of effort on all green plants from a number of laboratories, while Paul Kenrick partly concentrated on problems encountered when information from early land plant fossils is added to the data matrix. The fossil record for the earliest land plants was described by Charles Wellman, who kindly deputized for Jane Gray. It was she who first emphasized the importance of dispersed spores in Ordovician and Silurian rocks to understanding the affinities and nature of early land vegetation. From their configuration and from inferences based on reproductive biology and ecology of extant bryophytes she alerted palaeobotanical and botanical communities to a hitherto unappreciated phase of terrestrialization. Despite being desperately ill she managed to collaborate with Charles on the preparation of the paper presented here, the last she completed before her death in January 2000. Her incisive comments and encyclopaedic knowledge will be greatly missed. The only records of plants containing these spores (described here by Dianne Edwards) come from much younger rocks in the Lower Devonian, where they occur in very small, sometimes branching, axial fossils with terminal sporangia similar to those of the most simple vascular plants. Tracheidal architecture is now acknowledged as an important character in delimiting early land plants and has led to new researches on tracheid development with concomitant hypotheses on tracheid evolution, as summarized in Ned Friedman's paper. Unexpected diversity in early land plant conducting cells was recently discovered in a joint project between Jeff Duckett and Dianne Edwards, involving fossils and extant bryophytes. This work complements Jeff Duckett's long-standing collaboration with Roberto Ligrone and Karen Renzaglia, studies which are reported here and which, using developmental and ultrastructural approaches, question the long-accepted hypothesis that water-conducting cells of liverworts and mosses are homologous with each other and with tracheids. The functioning of the latter relies heavily on the presence of lignin—a polyphenolic macromolecule not yet identified in non-tracheophytes. The distribution and role of metabolic pathways involving polyphenol polymers are part of the content of John Raven's review of aspects of charophycean and embryophyte biochemistry, which also considers the extent to which differences in end products may be related functionally to the structure and physiology of plants adapted to life on land. David Read's review of mycotrophic relationships on lower land plants gives a clear message about the dangers of extrapolating function from morphology without experimental evidence, a luxury sadly not available to those currently describing a wide variety of fungi in early land plants and primitive soils.

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