The fungal colony

Fungi are amongst the simplest of eukaryotes. Their study has provided useful paradigms for processes that are fundamental to the way in which higher cells grow, divide, establish form and shape, and communicate with one another. The majority of work has been carried out on the budding yeast *Saccharomyces cerevisiae*, but in nature unicellular fungi are greatly outnumbered by filamentous forms, for which our knowledge is much less well developed. This volume focuses on the analysis of the filamentous life style, particularly on the hyphae which constitute the fungal mycelial colony. It provides the most recent insights into the molecular genetics and physiological mechanisms underlying the elaboration of the branching mycelium and the interactions between individual fungal mycelia. As such it offers much to interest mycologists and, equally, those working in the fields of cell biology, developmental biology, physiology and biochemistry.

The fungal colony

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Preface

Fungi are amongst the simplest of eukaryotes and have become useful paradigms for processes that are fundamental to the way in which higher cells grow, divide, establish form and shape and communicate with one another. Leading the way has been the budding yeast *Saccharomyces cerevisiae* whose ease of manipulation and accessible systems for sexual and molecular genetics have spearheaded basic investigations into fundamental processes as diverse as the analysis of the cell cycle, to investigations of longevity. Although unicellular fungi are greatly outnumbered in nature by the moulds our knowledge of them is much less developed than in this single yeast species. The true hallmark of the filamentous fungus is the hypha – tubular tip-growing cells that are the constituent components of the fungal mycelial colony. This work is dedicated to the analysis of the filamentous life style of fungi, the elaboration of the branching mycelium and the interactions between fungal mycelia. Mycelial fungi also offer major and exciting opportunities for cell and developmental biologists, physiologists, biochemists and developmental biologists. For example, the fungal hypha and the branching mycelium is an excellent system in which to explore the regulation of polarized cell growth, intracellular transport and signalling, how nuclei interact within a common cytoplasm, how genetically similar and dissimilar species interact and recognize one another and how growth responses can be coordinated as an organism explores and infiltrates a heterogeneous environment.

These themes form the rationale for this work. The chapters, all written by leading authorities in their fields, represent the frontiers in research into the molecular and cell biology of moulds, their physiology and the relationship between their filamentous growth habit and their ecology. The first four chapters deal with the properties of intact mycelia, their

response to their environment and the signalling systems that articulate environmental sensing. Chapter 4 to 8 deal with metabolism, biochemistry, enzyme secretion, and responses to toxic metal stress in fungi that are important to humans in the manufacture of single cell protein or as wood-rotting fungi or potential remediators of environmental pollutants. Three chapters deal with recent developments in the molecular analysis of tip growth, branching and associated cell cycle regulation. The final three contributions then consider the ways in which genetic information is exchanged during mating, stabilized within large ceonocytic compartments of long-lived individual mycelia and expressed in dikaryotic or monokaryotic hyphae. Together these chapters illustrate how the fungal colony represents a highly adaptive and successful growth form in natural environments and a structure that offers many insights into how unicellular life ramifies into multicellularity so that the properties of the whole mycelium exceeds the sum of its hyphal parts.

The ecology and exploitability of fungi give many of these fundamental studies an important applied dimension. Curious, then, to consider that the vast majority of fungal species remain undescribed, uncharacterized, and that support for mycology is under increasing threat.

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