

Preface

It is impossible to imagine a world without plants. They are the dominant species in most of our ecosystems, and the adaptation of plants to the land depended on the evolution and diversity of their cell walls. All plants evolved from a leafless, rootless, freshwater alga about 400 million years ago. To survive on the land over this time, plants were able to transport water, often to great heights, resist strong mechanical forces, withstand transient changes in drought, heat, cold, attacks by pests and pathogens, and adapt to long-term climate change.

Our human existence and our survival on this Earth are absolutely dependent on plants and their cell walls. With their unique ability to capture carbon, plants are at the core of our human food chain. They gave rise to much of our fossil fuels and their cell walls provide our wood, pulp and paper, our cotton and linen, gums and thickeners, and some chemical feedstocks. Crucial aspects of the plant's own biology are also underpinned by their cell walls, from their growth and development, breeding potential and agricultural utility to their responses to disease and stress. Cell walls affect almost all areas of plant biology and it is hard to underestimate their importance. Two factors make it particularly timely to survey this important area of science in its broader context.

First is the leap in our understanding of cell wall biology in the last couple of decades. New imaging techniques, advances in carbohydrate chemistry, plant genome sequencing and the power of molecular genetics, have all combined to enrich our appreciation of the beauty and complexity of walls and their functions. Second is our increasing awareness of the importance of cell walls, as a renewable resource and as carbon sinks in the global carbon cycle. With the potential for conversion of plant cell walls to liquid biofuels, interest has turned to the utility of plant walls as readily renewable lignocellulosic biomass, in contrast to our non-renewable sources of energy, coal and petroleum.

The book you hold is designed to provide a cell wall-oriented view of much of contemporary plant biology. It covers in some detail, plant anatomy, plant biochemistry and metabolism, plant cell biology, cell wall biosynthesis, plant growth and development, plant-microbe interactions and our use of walls as a renewable material resource. Much of basic plant science is inextricably wrapped up with the science of cell walls; that curious extracellular matrix that co-evolved with the plant's sessile and photosynthetic lifestyle. This complex structure lies at the heart of modern molecular plant biology.

Our book is aimed generally at university students, including both upper-level undergraduates, and graduate students, who want to understand plants better, and in their broader context. It is also a sufficiently up-to-date and detailed account to serve as a professional-level reference book.

The book is written and organized in a "concept" format, using short, didactically helpful concept heads; a device we feel helps both the reader's perspective and understanding of the material. The book's internal cross referencing system is designed so that the reader is directed to the relevant concept, as follows: Concept 6B11 refers to Chapter 6, section B, heading 11. The text is visually enriched with an integrated illustration program of over 400 figures, panels and micrographs. Additionally, the images and tables from the book are available in JPEG and can be accessed at www.garlandscience.com/pcw. At the end of each chapter are sets of key terms to help review learning, and a set of literature references for each concept heading, which provide an entry to the relevant research literature. Panels throughout the book bring together important reference material that is useful beyond the confines of its immediate context. A good example is Panel 6.2, *Plant cell wall architecture: models*. This panel condenses a lot of structural data about which molecules are where within cell walls, and presents a series of provisional structural models that help visualize cell wall architecture. It is reprinted as a frontispiece, for easy reference, because it is relevant to all chapters in the book.

This book has taken a long time to complete. When we started to write the book, many factors, such as biomass for energy, had much less significance, but we are in fact pleased that the book appears now, when the science is so much better understood and the environmental and economic relevance is that much higher. The book had its genesis in several meetings, convened initially by Peter Albersheim and with encouragement and financial support provided by Bob Rabson of the Department of Energy, where we argued fervently about what should and should not be in it, concept by concept. These long and energetic meetings were held in the wonderful remoteness of the English Manor Inns in Clayton, Georgia, close to the place chosen to film *Deliverance*! At that point Joe Varner, an inspirational plant biochemist, was an active, engaged and vocal team member, up until, indeed, his sad death in 1995. The book was reenergized when Ron Sederoff joined the team, and more regular writing sessions were held in the more salubrious facilities at the CCRC labs in Athens, Georgia. The final push to update and finish came partly through the increasing pace of remarkable discoveries in the field, all demanding space in the book, but also through the patient, tireless, energy and enthusiasm of our editor at Garland Science, Denise Schanck, without whom we would never have made it.

Denise was not alone in support of our endeavor, and we have been helped by a large number of talented individuals along the way. They include Rosemary Nuri and Karen Howard at the CCRC and Sigrid Masson, Emma Jeffcock and, in the early stages, Miranda Robertson, at Garland Science and our colleagues who generously commented on chapters. Nigel Orme transformed our labored hand-drawn figures into graphically pleasing output. And our friends, colleagues, lab members and families provided that essential, loyal but critical bedrock without which books like this would never emerge.

The whole area of plant science is in a state of flux as genomes become sequenced, bioinformatic and genetic tools become more sophisticated, structural and chemical methods advance and commercial interest in cell walls and their uses becomes more obvious. While celebrating the insights we now have into the cell walls of plants, we also want to emphasize that all is certainly not known. Huge areas of real ignorance remain, yet the potential impact that cell wall research could have for enhanced crop protection, agricultural yield, biomass use, and renewable chemical feedstock has never been more obvious. For all those new cell wall researchers, who will solve many of these problems, this book is written.

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