Preface

Plants cannot move away from their environments. As a result, all plants that survive to date have evolved sophisticated signaling mechanisms that allow them to perceive, respond, and adapt to the constantly changing environmental conditions. Among the many cellular processes that respond to environmental changes, elevation of calcium levels is by far the most universal messenger that couple the primary signals to the cellular responses. It has been puzzling how calcium, a simple cation, translates so many different signals into distinct responses – how is the "specificity" of signal–response coupling encoded within the calcium changes?

Recent research has established a concept called the "calcium signature": each different signal produces a unique calcium change. Such changes entail not only an elevation in concentration but also changes in the temporal and spatial patterns. In other words, a primary signal activates a number of calcium channels and/or pumps located in the various compartments of a plant cell resulting in fluxes of calcium in a particular space with a unique time course. For instance, a signal can produce a calcium "wave" (or a spiking pattern) along the time course in a particular compartment such as cytosol or nucleus. The combination of these temporal and spatial parameters constitutes a four-dimensional pattern unique to an external signal and thus forms the "signature" of each signal. To the plant cell, each calcium signature serves as a secret "code" with specific meaning for cellular response. The molecular components that mediate and regulate the calcium fluxes are involved in the "coding" processes of calcium signals. In order to translate a code into the changes in cellular activities, a cell must be equipped with mechanisms that interpret the meaning of a specific code through the "decoding" process. The molecules involved in the decoding can be referred to as decoders. Therefore, all calcium signaling pathways in plants (or animals) consist of coding and decoding processes, and research in this field is this all about understanding these coding and decoding mechanisms. I thus find the name of this book broadly covering activities in plant calcium signaling research.

Starting with a historical perspective from a pioneer of plant calcium signaling, this book introduces the recent advances in our knowledge of calcium signaling in

various model systems including stomatal guard cells, pollen tubes, and root hairs; followed by coverage of calcium channels in both plants and algal systems exploring evolutionary relationship of the "coding" process; and finished with a variety of molecular players in the "decoding" processes. In all chapters, readers will find the basic background information, current state-of-art in the subject matter, and emerging topics or perspective on the challenges ahead. Indeed, this book is a condensed volume that will provide students as well as advanced researchers a handy and informative resource for a comprehensive understanding of this exciting area of research in plant signal transduction.

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