Preface

During my half century as a plant physiologist, I have lectured frequently to students and lay audiences alike on biological subjects involving both plants and animals. With only occasional exceptions, I have noted that my listeners tend to "turn off" at first when the discussion moves to plants. I am sure this disengagement was traceable to a perception that plants just don't seem to do anything.

But a little contact with modern plant biology can turn boredom into fascination and avoidance into eager study. I discovered this myself at Cornell University in 1936 as a young student bound for veterinary school, who happened by chance to take a freshman botany course merely to round out an otherwise full course schedule. I have been forever grateful for the serendipity that brought me into contact with Loren Petry, a bearded, pipe-smoking paleobotanist whose elegant lectures enthralled me and whose Saturday evening informal discussions on any subject in the world changed the pattern of my life. Thanks to him, I began to see plants as the responsive and complex organisms they are. We are blinded to their sensitivity and complexity by their differences from the animal world, yet these very differences are the source of their fascination.

Consider for a moment how "clever" plants are, and how they solve many of the major problems of life smoothly, without noise, waste, or pollution. Their conversion of light into chemical energy for basic nutrition is still unequaled by the best human engineers, and it requires only the simplest of building blocks, namely water and carbon dioxide. Unsurpassed as organic chemists, they are also ingenious engineers. They can raise water to a height of 300 feet, using only the energy of the sun. They package their dormant seeds and buds with insulation and waterproofing agents that would make any designer envious. Although fixed in one location by their roots, they move crisply when necessary to accomplish vital tasks, without the muscle and nervous system we think of as necessary for motion. Among the most unexpected characteristics of plants is their time-telling ability. Plants can measure the time of day within a few minutes, and they can tell the date with enough accuracy to forestall injury or death from seasonal challenges.

Plants also have a busy social life, interacting with other creatures in a multitude of ways. They ward off insect predators by physical devices and defensive chemical weapons, but attract helpful organisms by variations of the same themes. They have learned to cooperate with bacteria and fungi, and even use certain bacteria to carry out genetic engineering in their cells. Certainly such extraordinary creatures are worthy of our diligent study and emulation!

One of the most remarkable powers of plants is their ability to regenerate organs; even an ordinary single cell can build the entire organism. Because of their regenerative abilities and the existence of bacteria able to transform their cells, plants have become the center of a new biotechnology industry. Humankind is developing a new power to genetically engineer plants that will revolutionize both agriculture and our own understanding of these organisms.

My undergraduate years at Cornell offered a glimpse of the remarkable abilities of plants that widened as I continued my studies. Harry Fuller, my graduate adviser at the University of Illinois, opened my eyes to the excitement of plant developmental biology, especially photoperiodism and plant hormones. In his wisdom, he had me research the physiology of flower formation in a then new agricultural plant, the soybean. My thesis title was corrupted by my fellow graduate students to "The Sex Life of the Soybean"; it didn't sell well, but it got me my graduate degree. Later, as a postdoctoral fellow in the laboratory of James Bonner at Caltech, I caught research fever and learned how independent workers in a common laboratory could stimulate one another by word and deed. It has been a happy journey since then. In this book, I would like to share with readers some of the joy that the study of how plants work has brought to me.

Academic life at most universities involves both research and teaching, since the understanding that flows from research is supposed to increase one's expository skills. Despite this credo, most universities find themselves unable to support financially the research of their faculty members. My scientific career would have been impossible without periodic grants and fellowships from private and public foundations. Thanks are due to the Guggenheim, Fulbright, and National Science Foundations for fellowships permitting study in Stockholm (1950–51), Canberra (1960–61), and London (1968), respectively. I am also deeply grateful to Yale University for its enlightened Triennial Leave of Absence policy, which facilitated shorter periods of study at Stanford; Cambridge, U.K.; Rehovot, Israel; and Tokyo. The National Science Foundation has supported my research throughout my academic career, from the year of the Founda-

tion's creation to the year before my retirement. The National Institutes of Health, American Cancer Society, Herman Frasch Foundation, U.S.-Israel Binational Agricultural Research and Development Fund, and the Albert Nerken Fund have also aided in some years. The National Aeronautics and Space Administration deserves special thanks for continuing its support into my formal "retirement," which is turning out to be very active, indeed. I also thank Yale University for its enlightened policy permitting retirees to continue an active scholarly life.

Writing a book on science for the intelligent lay public is difficult at best, and those of us who have contributed mainly to scientific journals for many years are doubly handicapped by our enforced editorial conformity to a generally deadening style. I thank my editor, Susan Moran, for helping me to rediscover "peoplespeak," a form of the English language not widely used by the scientific professional, but useful in communicating ideas directly to lay people. I am also indebted to Travis Amos, whose skill in locating appropriate photographs has helped make this book so attractive. Janet Tannenbaum has aided greatly in the final stages, and others at the editorial offices of the Scientific American Library have also made the cooperative production of this book mostly a pleasure. The sympathetic understanding of family and friends has of course been absolutely essential to the sustained effort required to produce this book.

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