PLANT MEMBRANE TRANSPORT: THE CURRENT POSITION

Editors

J. DAINTY, M.I. DE MICHELIS, E. MARRÈ and F. RASI-CALDOGNO

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PREFACE

The Eighth International Workshop on Plant Membrane Transport was held in Venice from 25 to 30 June, 1989. Such International Workshops started in 1968 at Reinhartsbrun and have taken place roughly every three years since. They started, and have continued, in the belief that no matter how specialized the particular fields of the contributors might be, they all represent complementary parts of a whole; the particular transport processes must be seen as integrated with other cell activities and these with the organism and indeed with life in general. The scope of the subject of plant membrane transport has evolved over the twenty year period of these workshops. In the early days, at least as reported at these meetings, research on transport was carried out from a rather biophysical point of view. One might argue that such a physico-chemical approach is a logical one for setting out the overall constraints on transport processes, although it perhaps more likely reflected the prejudices of the organisers of the first workshops. Be that as it may, the necessary integration of biophysics with biochemistry and, in general, with cell physiology was then just beginning. But soon integration between these approaches and their methodologies was rather satisfactorily accomplished. More recently we have the gratifying fruits of the utilization of the methods of molecular biology and molecular genetics as is evident for instance in the progress in the understanding of the nature and activity of membrane transport ATPases.

The eighth workshop was organized around five major topics and all the contributions, of whatever length, are included in this book. In addition there were five Round Table Discussions which are also completely reported. We believe that the book contains a complete and comprehensive account of the state of knowledge of and research into plant membrane transport as seen in the middle of 1989 and the integrated approach – biophysical, biochemical, cell physiological, molecular biological – is clearly evident.

Two of the five major topics are concerned with the bounding membranes: the plasma membrane and the tonoplast. Many of the papers on these membranes are concerned with what might be considered the primary active transport process, that of pumping protons either to the exterior or to the vacuole, and with the subsequent secondary transports using the proton motive force created by the primary pumps, whether powered by ATP or by pyrophosphate. Another group of papers is concerned with the passive ion channels through these membranes. The important, yet contentious, subject of redox systems at the plasma membrane is also thoroughly discussed. The essential role of calcium and how its level in the cytoplasm is controlled is another major topic extensively reported here. Both the calcium pumping ATPases of the plasma membrane and of the endoplasmic reticulum and the proton/calcium exchanger of the tonoplast are discussed; and such questions as how the cytoplasmic level of Ca^{2+} regulates the opening of ion channels, how calcium channel activity is related to inositol triphosphate, and how calcium transport is controlled by gibberellic acid, are treated. Perhaps the area in which our understanding lacks most is that of the relation between metabolism and transport and here many other contributions are grouped. Metabolic aspects particularly arise when considering the

action of hormones, phytotoxins – fusicoccin especially –, calmodulin and again calcium, and all these are the subjects of some of the papers in this area as of course are general questions on the regulation of proton pumps and on the metabolism of nitrate, malate and other crucial metabolites. The fifth major topic is the molecular biology of transport; discussed here are molecular cloning and analyses of the plasma membrane (E-P) proton ATPase, the tonoplast V-proton ATPase and translocating proteins such as the chloroplast phosphate translocator and the proton/glucose cotransporter.

Three special topics of great, or so it seemed to us, contemporary interest were chosen and Round Table Discussions were organised around each of them and are fully reported on in the book. 'Problems and utility of patch-clamp' is concerned with a valuable electrophysiological technique which is a very fashionable; some of the difficulties and pitfalls in its use are discussed. 'Water' is always an exciting, contentious and important aspect of membrane transport and some interesting polemics developed. And the apoplast, discussed in 'What is happening in the apoplast' is a very neglected part of the plant, sitting next to the plasma membrane.

It will be clear from a perusal of the book that the workshop was largely concerned with so-called fundamental research. But of course, transport has obvious roles in applied research, which in itself is both valuable and necessary; and it is helpful in extending and deepening our basic understanding. There were two 'applied' Round Table Discussions: on 'Transport and translocation as limiting factors in plant productivity' and on the 'Role of transport processes in resistance and adaptation to stress'. In these fully-reported discussions there is an attempted integration of fundamental knowledge for the solution of applied problems; they illustrate that transport processes are involved in these problems, whether those of mineral nutrition, gas exchange through stomata, translocation of nutrients, water relations, stress or hormone transport and distribution.

It has been a pleasure for us to organize this important meeting and edit this book, which we believe and hope will prove invaluable not only to all research workers on plant membrane transport but to all plant scientists whether students or workers in wider fields. The next Plant Membrane Transport International Workshop will be held at Asilomar in California in 1992 and we expect it to be just as successful as the Venice meeting has been.

The Workshop would not have been possible without the generous financial support and the constant interest of the Istituto Nazionale per la Cerealicoltura of the Ministero Italiano Agricoltura e Foreste, the Consiglio Nazionale delle Ricerche and the Regione Veneto. We also wish to acknowledge the support of the following institutions: Università degli Studi di Milano, Dipartimento di Biologia dell'Università degli Studi di Milano, Ente Nazionale per le Energie Alternative, Azienda di Promozione Turistica di Venezia, Instituto Universitario di Architettura di Venezia, Cassa di Risparmio di Venezia, Assessorato ai Lavori Pubblici del Comune di Venezia. We also add a special thanks for the kind, friendly hospitality of the Scuola Grande di San Giovanni Evangelista; the atmosphere of the Scuola Grande greatly enhanced our meeting.

Milan, July 1989

Jack Dainty
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CONTENTS

TRANSPORT AT THE PLASMA MEMBRANE

TRANSPORT AT THE TONOPLAST

CALCIUM AND MEMBRANE TRANSPORT

TRANSPORT PROCESSES: METABOLIC IMPLICATIONS AND ASPECTS OF CONTROL

BIOCHEMISTRY AND MOLECULAR BIOLOGY OF TRANSPORT

PROBLEMS AND UTILITY OF PATCH CLAMP

WATER

WHAT IS HAPPENING IN THE APOPLAST?

TRANSPORT AND TRANSLOCATION

ROLE OF TRANSPORT PROCESSES IN RESISTANCE AND ADAPTATION TO STRESS