

Preface

During recent years research in photosynthesis has considerably expanded and it is often difficult for a worker in one particular area to keep abreast with progress and development of new concepts in other parts of the field. This is a pity and can have serious implications as it may lead to fragmentation of research which would benefit by being coordinated. The aim of this new series on photosynthesis is to produce volumes which will attempt to develop a particular theme making them useful both to specialists and non-specialists.

This volume, the first of the series, deals with the structural, biophysical, biochemical and physiological aspects of intact chloroplasts. That is, the chloroplast is dealt with as a complete organelle retaining both its intrathylakoid and stromal compartments. The stroma is not only considered in terms of its biochemical activity but also as a physiological medium for the thylakoid membranes. It is now clear that the photochemical and electron transfer events of photosynthesis are to some extent under the control of the biochemical activity and ionic composition of the stroma and the importance of these interrelationships is discussed in the earlier chapters of this book. The later chapters deal more with the biochemical activity of chloroplasts and like the earlier chapters emphasise the role of the outer chloroplast membranes or envelope as a biochemically active diffusion barrier. They also raise the question of the autonomy of the organelle within the intact cell. Various biochemical interactions between the chloroplast and cytoplasm are dealt with and the last chapter gives an overall picture of the collaborative integration of chloroplast and cytoplasmic functioning.

Contributors have written within the theme of the title by developing their own individual approach but where necessary have provided sufficient background concepts to make the book valuable to students and non-specialists. I have tried to maintain continuity throughout and there is extensive cross referencing.

In chapter 1 Jim Coombs and Denis Greenwood have given a comprehensive account of higher plant chloroplast structure and have also discussed in some detail the structural characteristics of the photosynthetic apparatus of algae. The diversity of algal chloroplast structure raises some important points not only about the origin of higher plant chloroplasts but also about the relationships between chloroplast structure and function. The next two chapters by Willem Vredenberg and myself respectively describe how changes in the ionic composition of the chloroplast's compartments can affect primary photochemical events giving rise to phenomena such as electrical potential differences, energy and electron transfer processes and changes in chlorophyll fluorescence yield. Chapter 4 by David Hall and chapter 5 by Heinrich Krause and Ulrich Heber essentially deal with the mechanisms of light induced

ATP and NADPH production and discuss how the relative concentrations of these two substances change in the chloroplast under different conditions. The role of the outer membranes in controlling movements of metabolites in and out of the chloroplast is also discussed in chapter 4 but is considered in greater detail in chapter 6 by Hans Heldt. In chapters 7 and 8 David Walker and Jim Coombs respectively have presented up-to-date accounts of photosynthetic CO_2 fixation in both C3 and C4 metabolism. David Walker has discussed photosynthetic induction in terms of the autocatalytic nature of the Calvin cycle while Jim Coombs has dealt with C4 metabolism on a broad basis emphasising the problems of the complexity of conventional schemes. The ability of chloroplasts to produce reducing power for reduction processes other than CO_2 fixation is emphasised in chapter 9 by Jens Schwenn and Achim Trebst on the photoassimilation of SO_4^{2-} and in chapter 11. In chapter 11, Rachel Leech and Denis Murphy deal with NO_3^- reduction and amino acid synthesis as well as discussing the role of chloroplasts in lipid synthesis. These and earlier chapters clearly indicate that the intact chloroplast is not an autonomous organelle and this is emphasised by John Ellis in chapter 10 in which he outlines the limitations of chloroplasts in producing their own proteins and nucleic acids. The final chapter by John Raven calls on much of the knowledge presented in the preceding chapters and discusses the sharing of reduced carbon, ATP and photoreductant between the chloroplast and cytoplasm in intact cells.

Overall the book emphasises that in order to obtain a full description of photosynthesis it will be necessary to identify all those processes which take place within chloroplasts and define the relationships of these processes with each other and with cytoplasmic functioning. Much of the knowledge presented in the book has been gained by using isolated chloroplasts having functional envelopes and classified as Type A by David Hall (see chapter 4). These are ideal preparations for bridging the gap between studies with conventional broken chloroplasts and intact cells and have the distinct experimental advantage in that simple removal of the outer membrane by osmotic shock can be compensated by "reconstitution" of the suspending media to a condition which mimics the stroma. Such a technique has played a particularly important part in our present day understanding of CO_2 fixation as emphasised by David Walker in chapter 7 and I am sure will represent an important approach for future research into various aspects of the photosynthetic processes.

It has given me considerable pleasure to edit this volume and I thank the contributors for presenting their specialised knowledge in a clear and comprehensive manner. I also thank my colleagues, Alison Telfer, Mike Hipkins, John Mills and Geoff Searle for their help and in particular I would like to thank my wife, Lyn, and Jennifer Nicolson who bore the brunt of the tedious jobs which befall both a contributor and an editor. Finally, it is with great respect that I thank Robin Hill for writing the foreword for this book and acknow-

ledge his outstanding contributions to our present day knowledge of photosynthesis.

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