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0521294436 - Photosynthesis: Physical Mechanisms and Chemical Patterns - Roderick K. Clayton

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Photosynthesis

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Photosynthesis

Physical mechanisms and chemical patterns

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Cornell University, Ithaca, New York

CAMBRIDGE UNIVERSITY PRESS

CAMBRIDGE

LONDON NEW YORK NEW ROCHELLE

MELBOURNE SYDNEY

Cambridge University Press

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Published by the Press Syndicate of the University of Cambridge
The Pitt Building, Trumpington Street, Cambridge CB2 1RP
32 East 57th Street, New York, NY 10022, USA
296 Beaconsfield Parade, Middle Park, Melbourne 3206, Australia

© Cambridge University Press 1980

First published 1980

Typeset by Automated Composition Service Inc., Lancaster, Pennsylvania

Library of Congress Cataloging in Publication Data

Clayton, Roderick K.

Photosynthesis.

(IUPAB biophysics series; 4)

Includes bibliographies and index.

1. Photosynthesis – Research. 2. Photosynthesis.

I. Title. II. Series: International Union for
Pure and Applied Biophysics. IUPAB biophysics
series; 4.

QK882.C58 581.1'3342 79-27543

ISBN 0 521 22300 8 hard covers

ISBN 0 521 29443 6 paperback

Transferred to digital printing 2003

Cambridge University Press

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Frontmatter

[More information](#)

To B. J. Clayton, wife and colleague

CONTENTS

<i>Foreword</i>	<i>page</i>	xi
<i>Preface</i>		xiii
 Part I. Research in photosynthesis: basic developments to about 1960		1
1 The chemical nature of photosynthesis		3
1.1 <i>Early history</i>		3
1.2 <i>Photosynthesis as an oxidation–reduction process</i>		4
1.3 <i>Digression: qualitative aspects of oxidation and reduction</i>		6
1.4 <i>Modifications of van Niel’s representation of photosynthesis</i>		8
1.5 <i>Digression: structures of some molecules important in photosynthesis</i>		15
<i>Suggested readings</i>		18
2 The roles of chlorophylls and other pigments		19
2.1 <i>Digression: light and molecules; excited states and energy transfer</i>		19
2.2 <i>Two functions of chlorophyll: light harvesting and photochemistry</i>		27
2.3 <i>The evolution of photosynthetic organisms and the impact of oxygen in the biosphere</i>		31
2.4 <i>The diversification of photosynthetic pigments</i>		37
2.5 <i>Digression: factors that govern the migration of excitation energy among antenna pigments and to photochemical reaction centers</i>		39
2.6 <i>The organization of antenna pigments in relation to energy transfer</i>		43
<i>Suggested readings</i>		49
3 The cooperation of two quanta or two photosystems in photosynthesis		51
3.1 <i>The quantum efficiency of photosynthesis: a renowned former controversy</i>		51
		vii

Cambridge University Press

0521294436 - Photosynthesis: Physical Mechanisms and Chemical Patterns - Roderick K.

Clayton

Frontmatter

[More information](#)

viii	<i>Contents</i>	
3.2	<i>Evidence for two distinct components of chlorophyll and two photochemical systems in oxygen-evolving photosynthesis</i>	53
	<i>Suggested readings</i>	58
4	Major digression: molecular physics and spectroscopy; quantum energy and redox energy; measurements involving light	59
4.1	<i>Covalent bonding; electron spin, radicals, and triplet states; microwave spectroscopy</i>	59
4.2	<i>Molecular spectroscopy: electron orbitals, energy states, and optical absorption spectra</i>	63
4.3	<i>Quantum energy and the energy of oxidation and reduction</i>	67
4.4	<i>The measurement of light and its uses in photobiology</i>	71
	<i>Suggested readings</i>	78
	Part II. Pigment-protein complexes in photosynthetic membranes: their compositions, structures, and functions	79
5	Components of the photosynthetic membranes of bacteria: composition and function in energy transfer and photochemistry	88
5.1	<i>The photochemical reaction centers</i>	88
5.2	<i>Digression: relationships between absorption, fluorescence, and photochemistry</i>	97
5.3	<i>Fluorescence in reaction centers and in photosynthetic membranes, in relation to energy transfer and photochemistry</i>	101
5.4	<i>Antenna pigment-protein components: varieties, association with reaction centers, and physiological regulation</i>	105
	<i>Suggested readings</i>	109
6	Photosynthetic membranes of plants: components and their molecular organization; energy transfer and its regulation	111
6.1	<i>Pigment-protein components of chloroplasts; their relation to gross visible structures and to Photosystems 1 and 2</i>	111
6.2	<i>Fine structure of thylakoid membranes as seen with the electron microscope; relation of structural features to functional components</i>	116
6.3	<i>Fluorescence and energy transfer in the thylakoid membrane, and the control of quantum distribution to the two photosystems</i>	119
6.4	<i>Antenna components and energy transfer in diverse types of algae and bacteria</i>	125
	<i>Suggested readings</i>	130
7	Measurements with polarized light: interactions of molecules in excited states; orientations of pigments in photosynthetic tissues	132

Cambridge University Press

0521294436 - Photosynthesis: Physical Mechanisms and Chemical Patterns - Roderick K.

Clayton

Frontmatter

[More information](#)

<i>Contents</i>	ix
7.1 <i>Digression: theory and general methods involving polarized light</i>	132
7.2 <i>Spectroscopy of chlorophylls; measurements with polarized light as applied to photosynthetic tissues</i>	146
<i>Suggested readings</i>	162
Part III. Photochemical charge separation, secondary transport of electrons and protons, and oxygen evolution	165
8 Reaction centers: photochemical charge separation and interaction with nearest electron donors and acceptors	167
8.1 <i>Charge separation in reaction centers of photosynthetic bacteria</i>	167
8.2 <i>Reaction centers of Photosystems 1 and 2 of green plants and algae</i>	180
<i>Suggested readings</i>	190
9 Oxygen evolution; secondary transport of electrons and protons	193
9.1 <i>Photosynthetic oxygen evolution</i>	193
9.2 <i>Patterns of electron and proton transport surrounding Photosystems 1 and 2</i>	203
9.3 <i>Patterns of electron and proton transport in photosynthetic bacteria</i>	213
<i>Suggested readings</i>	226
Part IV. The formation of ATP and the assimilation of carbon dioxide	229
10 Electrochemical gradients and the formation of ATP	231
10.1 <i>Hypotheses for the coupling of electron transport to ATP formation</i>	231
10.2 <i>Light-induced electrochemical gradients in photosynthetic membranes</i>	237
10.3 <i>ATP formation and the energy efficiency of photosynthesis</i>	248
<i>Suggested readings</i>	254
11 Carbon assimilation by plants	256
11.1 <i>The reductive pentose cycle; photorespiration</i>	256
11.2 <i>The pyruvate carboxylation pathway</i>	260
<i>Suggested readings</i>	261
Epilogue: Some directions of basic and applied research on photosynthesis	263
<i>Notes</i>	266
<i>Index</i>	277

Cambridge University Press

0521294436 - Photosynthesis: Physical Mechanisms and Chemical Patterns - Roderick K. Clayton

Frontmatter

[More information](#)

FOREWORD

The origins of this series were a number of discussions in the Education Committee and in the Council of the International Union of Pure and Applied Biophysics (IUPAB). The subject of the discussions was the writing of a textbook in biophysics; the driving force behind the talks was Professor Aharon Katchalsky, first while he was president of the Union, and later as the honorary vice-president.

As discussions progressed, the concept of a unified text was gradually replaced by that of a series of short inexpensive volumes, each devoted to a single topic. It was felt that this format would be more flexible and more suitable in light of the rapid advances in many areas of biophysics at present. Instructors can use the volumes in various combinations according to the needs of their courses; new volumes can be issued as new fields become important and as current texts become obsolete.

The International Union of Pure and Applied Biophysics was motivated to participate in the publication of such a series for two reasons. First, the Union is in a position to give advice on the need for texts in various areas. Second, and even more important, it can help in the search for authors who have both the specific scientific background and the breadth of vision needed to organize the knowledge in their fields in a useful and lasting way.

The texts are designed for students in the last years of the standard university curriculum and for Ph.D. and M.D. candidates taking advanced courses. They should also provide a suitable introduction for someone about to begin research in a particular field of biophysics. The Union is pleased to collaborate with the Cambridge University Press in making these texts available to students and scientists throughout the world.

Franklin Hutchinson, Yale University
Watson Fuller, University of Keele
Lorin J. Mullins, University of Maryland
Editors

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[More information](#)

PREFACE

The aim of this book is to introduce students of science to the methods and present state of research in photosynthesis. As befits a monograph on a topic in biophysics, physicochemical aspects of the subject are emphasized. The treatment of metabolic and physiological areas is confined to the earlier phases of ATP formation and carbon assimilation. The treatment of physical aspects is weighted heavily toward bacterial photosynthesis because the photosynthetic bacteria have afforded exceptional opportunities in elucidating physical mechanisms.

Part I describes major developments from about 1650 to 1960, emphasizing the chemical nature of photosynthesis and the roles of chlorophylls and other pigments. Part II reviews our present knowledge of the structures and components of photosynthetic tissues in relation to their function. Part III deals with the photochemistry of photosynthesis, and with the patterns of chemical events, principally electron and proton transfer, that follow the photochemistry. Part IV treats the relationships of electron and proton transport to ATP formation, and the metabolic patterns of carbon assimilation. The epilogue exposes major areas of confusion and ignorance and indicates potentially fruitful directions of research, including the development of photosynthetic systems for solar energy conversion.

This book can provide the framework for a course on photosynthesis suitable for undergraduate or postgraduate students. To meet this purpose it includes digressions into physics and chemistry, as needed for a basic understanding of the subject. These digressions can of course be passed over by the reader who is familiar with their content; they are mainly descriptive rather than analytical. I have tried to impart a knowledge of photosynthesis at the level of contemporary research; nevertheless, a student will be sufficiently prepared if he understands physics, chemistry, and biology at the level of introductory college courses for science majors. The reader will detect some redundancy in widely separated parts of the book. This is deliberate and is based on the premise that a cyclical return to some topics will help to consolidate an overall grasp of a subject as multifarious and complex as photosynthesis. The treatment is detailed and comprehensive so that students and

Cambridge University Press

0521294436 - Photosynthesis: Physical Mechanisms and Chemical Patterns - Roderick K. Clayton

Frontmatter

[More information](#)

xiv *Preface*

mature investigators can visualize concretely what is required and involved in a career of research in photosynthesis.

Annotation has been restricted to a few references to specific experiments, plus a set of suggested readings at the end of each chapter. These readings are listed in the order of appearance of relevant material in the text.

I am indebted to Drs. W. L. Butler, R. E. McCarty, W. W. Parson, K. Sauer, and A. Vermeglio for valuable suggestions and critical comments on parts of this book.

R. K. C.