

Contents

PREFACE	v
CONTENTS	vii
INTRODUCTION	1

PART 1. THE BASIC PROCESSES

CHAPTER 1. PHYSICAL PROCESSES.	7
1. Light absorption and its direct consequence.	7
2. The formation of excited electronic states.	12
2.1 $\pi \rightarrow \pi^*$ transitions	13
2.2 $n \rightarrow \pi^*$ transitions	14
2.3 The triplet state.	15
3. Conversion of energy.	19
4. Electronic energy transfer.	21
4.1 Resonance migration	23
4.2 Charge migration.	26
5. The photophysical unit.	27
5.1 Single molecule unit	29
5.2 Molecular assembly unit.	29
6. Common fundamentals of photophysics and photochemistry.	30
CHAPTER 2. CHEMICAL PROCESSES.	31
1. Stabilisation of photoproducts.	31
1.1 Reaction mechanisms.	32
1.2 Rate-determining factors	41
2. Chemical energy transfer	46
2.1 Migratory transfer	46
2.2 Electron transfer.	49
3. Chemical light production.	52
CHAPTER 3. BIOLOGICAL PROCESSES.	54
1. Metabolism in general.	54

2. Growth	55
3. Aging	55
4. Adaptation	56
5. Regulatory processes	56

PART 2. THE BIOLOGICAL PHOTOPHENOMENA

CHAPTER 4. PHOTOSYNTHESIS	61
1. Introduction	61
2. The photosynthetic pigments	64
2.1 Chlorophylls	64
2.2 Carotenoids	105
2.3 Biliproteins	118
2.4 Phytochrome	123
2.5 Hematin compounds	124
3. The photoreceptive structures	127
3.1 Grana-containing chloroplasts	127
3.2 Grana-free chloroplasts	132
3.3 Chromatoplasm	133
3.4 Chromatophores	133
3.5 Free grana	134
4. The nature of the process	135
CHAPTER 5. VISION	154
1. Introduction	154
2. The visual pigments	155
2.1 Chemistry	155
2.2 Prosthetic groups of visual pigments	157
2.3 Opsins	158
2.4 The retinal-opsin bond	159
2.5 The individual visual pigments	163
3. The photoreceptive structures	182
4. The nature of the process	194
CHAPTER 6. PHOTOTAXIS	203
1. Introduction	203
2. The phototactic pigments	204
3. The photoreceptive structures	206
3.1 The eye	206
3.2 Chloroplasts and related structures	208
3.3 Dispersed phototactic receptors	208
3.4 The eyespot	209
3.5 The paraflagellar body	210
4. The nature of the process	211

4.1 Bacterial phototaxis	211
4.2 Phototaxis of flagellates.	212
4.3 Phototaxis of chloroplasts.	214
 CHAPTER 7. PHOTOKINESIS	 217
1. Introduction.	217
2. The photokinetic pigments	217
3. The photokinetic structures and the nature of the process.	218
 CHAPTER 8. PHOTODINESIS	 220
1. Introduction.	220
2. The photodinetic pigments	221
3. The photodinetic structures and the nature of the process.	222
 CHAPTER 9. PHOTOTROPISM.	 225
1. Introduction.	225
2. The phototropic pigments.	226
2.1 Riboflavin and related compounds.	227
2.2 Carotenoids	231
2.3 Chlorophyll derivatives	234
2.4 Phytochrome	234
2.5 Unknown pigment	234
2.6 Indoleacetic acid.	235
2.7 Retinal-opsin complexes	235
3. The phototropic structures	236
3.1 Growth-type structures	236
3.2 Turgor-type structures	239
4. The nature of the process	239
 CHAPTER 10. PHOTOMORPHOGENESIS	 244
1. Introduction.	244
2. The photomorphogenetic pigments	245
2.1 Phytochrome	245
2.2 Copper flavoproteins :	248
2.3 Other flavoproteins, riboflavin	249
2.4 Carotenoids	249
2.5 Visual pigments?	249
2.6 Pigments from encephalic photoreceptors	250
3. The photomorphogenetic structures.	252
3.1 In plants	252
3.2 In photosensitive animals	252
4. The nature of the process	254
4.1 In plants	255
4.2 In animals	257

PREFACE

CHAPTER 11. BIOLUMINESCENCE. 259

1. Introduction. 259

2. The emitting systems. 260

 2.1 Bacterial luminescence 260

 2.2 Fungal luminescence 267

 2.3 Firefly luminescence 268

 2.4 Other bioluminescences. 271

CHAPTER 12. CONCLUDING REMARKS 275

REFERENCES. 279

ABBREVIATIONS 312

INDEX 313