

## CONTENTS

LIST OF ILLUSTRATIONS	viii
PREFACE	x
<b>1 ENERGY AND THE HUMAN CONDITION</b>	
1.1 <i>The human population</i>	3
1.2 <i>The human condition</i>	6
1.3 <i>The demand for power</i>	9
1.4 <i>Meeting the demand</i>	14
1.5 <i>Energy income</i>	16
1.6 <i>Patterns of development</i>	18
<b>2 THE SUN AND THE EARTH</b>	
2.1 <i>The origin of solar energy</i>	23
2.2 <i>The solar radiation</i>	25
2.3 <i>Interaction with the earth's atmosphere</i>	27
2.4 <i>The apparent position of the sun</i>	30
2.5 <i>Intensity on a surface</i>	34
2.6 <i>Daily and yearly radiation</i>	39
2.7 <i>The promise</i>	42
<b>3 A REVIEW OF FIRST PRINCIPLES</b>	
3.1 <i>Reality and the conceptual model</i>	46
3.2 <i>Structure of matter</i>	48
3.3 <i>Energy</i>	50
3.4 <i>Heat and work</i>	52
3.5 <i>Temperature and the Zeroth Law</i>	53
3.6 <i>Scales of temperature and the ideal gas</i>	55
3.7 <i>Specific heat</i>	59
3.8 <i>The ideal gas and other substances</i>	60
3.9 <i>Units of thermodynamic quantities</i>	61

## CONTENTS

### 4 COLLECTION OF SOLAR ENERGY

4.1 <i>Elements of quantum theory</i>	63
4.2 <i>Interaction of radiation with bodies</i>	67
4.4 <i>Equilibrium temperature of irradiated bodies</i>	73
4.5 <i>Improvements to the flat-plate collector</i>	77
4.6 <i>The solar pond</i>	84
4.7 <i>Useful consequences of absorption of solar energy</i>	85

### 5 HEATING BY SOLAR ENERGY

5.1 <i>The time required to reach equilibrium</i>	87
5.2 <i>Solar cookers and furnaces</i>	90
5.3 <i>Heating of buildings and hot-water services</i>	92
5.4 <i>Storage of heat energy</i>	100
5.5 <i>Radiative cooling</i>	102
5.6 <i>Distillation of water</i>	105
5.7 <i>Other applications of solar heating</i>	

### 6 CONVERSION OF SOLAR ENERGY INTO WORK

6.1 <i>The first law of thermodynamics</i>	116
6.2 <i>The second law of thermodynamics</i>	119
6.3 <i>The efficiency of cyclic processes</i>	120
6.4 <i>Mechanical power generation by heat engines</i>	125
6.5 <i>Combined engine-collector performance</i>	133
6.6 <i>Heat engines with concentrating collectors</i>	136
6.7 <i>Cooling by solar power</i>	139

### 7 CONVERSION OF SOLAR ENERGY INTO ELECTRICITY

7.1 <i>Electrical current, potential and power</i>	148
7.2 <i>Electrons in solids</i>	153
7.3 <i>Energy distribution of electrons</i>	156
7.4 <i>The thermionic generator</i>	159
7.5 <i>Thermionic emission</i>	161
7.6 <i>Output and efficiency of thermionic generators</i>	164

7.7	<i>Thermionic generators and the Carnot efficiency</i>	170
7.8	<i>Thermoelectricity</i>	172
7.9	<i>The thermoelectric generator</i>	175
<b>8 PHOTOELECTRICITY</b>		
8.1	<i>The photoemissive generator</i>	183
8.2	<i>The photoelectric generator</i>	185
8.3	<i>Doped semiconductors</i>	188
8.4	<i>The junction diode</i>	192
8.5	<i>Output and efficiency of photoelectric generators</i>	194
8.6	<i>Development of photoelectric generators</i>	199
<b>9 PHOTOCHEMISTRY AND PHOTOBIOLOGY</b>		
9.1	<i>Photodissociation</i>	206
9.2	<i>Photosensitisation</i>	209
9.3	<i>Sensitisation of water photolysis</i>	213
9.4	<i>The photochemical cell</i>	215
9.5	<i>Photosynthesis</i>	219
9.6	<i>Plant culture for energy storage</i>	222
9.7	<i>Culture of lower plants</i>	224
9.8	<i>Energy recovery from plants</i>	227
<b>10 THE INTRODUCTION OF SOLAR POWER</b>		
10.1	<i>Intensity of solar energy</i>	230
10.2	<i>The variability of solar energy</i>	232
10.3	<i>Energy storage requirements</i>	235
10.4	<i>Economic factors</i>	239
10.5	<i>A place for sun-powered systems</i>	244
<b>SUGGESTIONS FOR FURTHER READING</b>		
<b>NAME INDEX</b>		
<b>SUBJECT INDEX</b>		
		249