
Contents

<i>Preface</i>	<i>page ix</i>
1 Introduction: centred optical systems	1
1.1 The common properties of optical instruments	1
1.2 Optical elements	1
1.3 Concepts in optical instrument design	3
1.4 Gaussian optics	11
1.5 Aberrations – a conspectus	13
2 Telescopes and binoculars	15
2.1 The visual telescope	15
2.2 Galilean telescopes	16
2.3 Keplerian refractors	17
2.4 Erecting telescopes	17
2.5 Binoculars	19
2.6 Applications of the refracting telescope	21
2.7 Reflecting telescopes	22
2.8 The Newtonian telescope	23
2.9 The Cassegrain telescope	23
2.10 Refractors versus reflectors	26
2.11 Focal reducers	27
2.12 Image rotators	29
3 Eyepieces, eyes and colour	30
3.1 Eyepieces	30
3.2 Eyepiece properties	32
3.3 Astronomical photography through an eyepiece	35
3.4 Visual observation	36

vi	Contents	
3.5	The eye as an optical instrument	38
3.6	The perception of colour	39
4	Cameras and camera lenses	43
4.1	Introduction: the photographic lens	43
4.2	The double Gauss lens	44
4.3	Telephoto lenses	45
4.4	Wide-angle lenses	45
4.5	Fish-eye lenses	47
4.6	Zoom lenses	49
4.7	Practical aspects	49
4.8	Architectural photography	51
4.9	Schlieren photography	51
4.10	The optical transfer function	54
4.11	The Boys points of a lens	55
5	The scientific CCD camera	57
5.1	The traditional silver halide camera	57
5.2	Scientific digital photography	60
5.3	Calibration	62
5.4	Radioactive lenses	62
6	Spectrometry	64
6.1	The prism spectroscope	64
6.2	The direct vision spectroscope	69
6.3	Diffraction grating spectrometry	70
6.4	Grating mountings	71
6.5	Concave gratings	76
6.6	Illumination of a spectrometer	77
6.7	Grating ghosts	80
6.8	The alignment of a grating spectrograph	81
7	Interferometers and their uses	84
7.1	Interferometry	84
7.2	Oscillation, phase and phase-difference	84
7.3	Coherence	85
7.4	Division of wavefront	86
7.5	Division of amplitude	88
7.6	Interferometers	88
7.7	The Fizeau interferometer	90
7.8	The Michelson interferometer	91
7.9	The Fabry–Pérot étalon	93

Contents	vii
7.10 The Mach–Zehnder interferometer	99
7.11 The Sagnac interferometer	101
7.12 Fine displacement measurement	102
7.13 Optical resonators	103
8 Electro-optical effects and their practical uses	104
8.1 Introduction: polarized light	104
8.2 Polarization effects	105
8.3 Polarizing elements	108
8.4 Laboratory uses of polarized light	109
8.5 Faraday effect	110
8.6 Kerr effect	111
8.7 Pockels effect	113
8.8 A practical example of applied polarizing effects	113
9 Microscopes and projectors	116
9.1 Projectors	116
9.2 The Fresnel lens	118
9.3 Microscopes	119
9.4 Köhler illumination	120
9.5 Travelling microscopes	122
10 Siderostats and coelostats	124
10.1 The celestial sphere	124
10.2 Equatorial telescope mountings	124
10.3 Coelostats	126
11 The detection and measurement of radiation	130
11.1 The geometry of radiation measurement	130
11.2 The detection of radiation	132
11.3 The classification of radiation detectors	133
11.4 The far infra-red	133
11.5 The middle infra-red	134
11.6 The UVOIR region	134
11.7 The far ultra-violet	136
11.8 Types of spectra	137
11.9 Black body radiation	138
12 Practicalities	141
12.1 Cleaning optical surfaces	141
12.2 Mounting optical parts	144
12.3 Optical filters	145

<i>Appendix A</i>	Gaussian optics	149
<i>Appendix B</i>	Optical aberrations	162
<i>Appendix C</i>	A brief introduction to Fourier optics	174
	<i>Further reading</i>	181
	<i>Index</i>	183