

Contents

	Preface	<i>page</i> xiii
Part I	Amateur astronomy	1
1	Using this book effectively	3
1.1	Amateur astronomy for a new generation	3
1.2	The maps are backward!	3
1.3	Old books	5
1.4	Material you can skip	5
1.5	Pronouncing foreign names	5
2	Observing sites and conditions	6
2.1	Darkness and night vision	6
2.1.1	Dark adaptation	6
2.1.2	Twilight and moonlight	7
2.1.3	Light pollution	7
2.1.4	Naked-eye limiting magnitude	8
2.1.5	The Bortle dark-sky scale	8
2.2	Atmospheric steadiness	12
2.3	Weather and the astronomer	13
2.3.1	Climate, weather, and seasons	13
2.3.2	Using satellite weather data	14
2.3.3	Dew	16
2.4	Observing at remote sites	18
2.4.1	Finding a site	18
2.4.2	Transporting the telescope	18
2.4.3	Site etiquette	19
2.4.4	Keeping warm	20
2.4.5	Mosquitoes	20
2.4.6	Other vermin	21
2.4.7	Safety	22

Contents

3	The Moon, the Sun, and eclipses	23
3.1	The Moon	23
3.1.1	Phases of the Moon	23
3.1.2	Why observe the Moon?	23
3.1.3	Names of lunar features	27
3.1.4	Coordinate systems	30
3.1.5	Observing programs	30
3.1.6	Lunar eclipses	31
3.1.7	Occultations	33
3.2	The Sun	33
3.2.1	Sun filters	33
3.2.2	Solar features	35
3.2.3	Solar eclipses	37
4	The planets	42
4.1	General concepts	42
4.2	The view from Earth	42
4.3	Mercury	44
4.3.1	Elongations of Mercury, 2002–2010	45
4.3.2	Transits of Mercury	47
4.3.3	Observing Mercury	47
4.4	Venus	47
4.4.1	Elongations of Venus, 2002–2010	47
4.4.2	Transits of Venus	48
4.4.3	Observing Venus	48
4.5	Mars	49
4.5.1	Oppositions of Mars, 2002–2010	49
4.5.2	Surface features of Mars	49
4.5.3	Named Martian features	51
4.5.4	Satellites of Mars	52
4.6	Jupiter	53
4.6.1	Oppositions of Jupiter, 2002–2010	53
4.6.2	Surface features of Jupiter	53
4.6.3	Satellites of Jupiter	55
4.7	Saturn	56
4.7.1	Oppositions of Saturn	56
4.7.2	Surface features of Saturn	56
4.7.3	Rings of Saturn	57
4.7.4	Satellites of Saturn	58
4.8	Uranus	59
4.8.1	Oppositions of Uranus	59
4.8.2	Surface features of Uranus	59
4.8.3	Satellites of Uranus	59
4.9	Neptune	60

Contents

4.9.1	Oppositions of Neptune	60
4.9.2	Surface features of Neptune	60
4.9.3	Satellites of Neptune	60
4.10	Pluto	60
4.10.1	Oppositions of Pluto	60
4.10.2	Telescopic appearance	61
4.10.3	Satellite of Pluto	61
5	Comets, asteroids (minor planets), and artificial satellites	62
5.1	Small objects in the Solar System	62
5.2	Orbits and ephemerides	62
5.3	Asteroids (minor planets)	63
5.3.1	Observing asteroids	63
5.3.2	Asteroid nomenclature and data	64
5.3.3	Finding asteroids with computerized telescopes	65
5.3.4	Discovering asteroids	66
5.4	Comets	67
5.4.1	Observing comets	67
5.4.2	Comet designations	68
5.4.3	Finding comets with computerized telescopes	69
5.4.4	How to discover a comet	70
5.4.5	Reporting a comet discovery	71
5.5	Meteors	72
5.6	Artificial Earth satellites	73
5.6.1	Observing satellites	73
5.6.2	Satellite orbits	73
5.6.3	Satellite data files	75
5.6.4	What to expect at the telescope	76
5.7	Orbital elements explained	77
6	Constellations	80
6.1	Constellation names	80
6.2	How the constellations got their names	84
6.3	Obsolete constellations	86
6.4	The zodiac	86
7	Stars – identification, nomenclature, and maps	87
7.1	Star names	87
7.1.1	Traditional names	87
7.1.2	Other star names	90
7.1.3	Stars named after people	90
7.2	Modern star designations	91
7.2.1	Bayer and Lacaille letters	91
7.2.2	Flamsteed numbers	93
7.2.3	STAR numbers	93

Contents

7.3	Star maps	93
7.3.1	Wide-field atlases	93
7.3.2	Medium-scale atlases	94
7.3.3	Telescopic atlases	94
7.3.4	How to use a telescopic atlas	95
7.3.5	Sky mapping software	97
7.3.6	Palomar Observatory Sky Survey	99
7.4	Star catalogues	100
7.4.1	Online libraries	100
7.4.2	SAO	100
7.4.3	Other bright star catalogues	101
7.4.4	Hubble Guide Star Catalog	101
7.4.5	Hipparcos and Tycho	101
7.4.6	The cross-indexing problem	102
7.4.7	Bayer/Flamsteed to SAO cross-index	102
8	Stars – physical properties	112
8.1	Magnitude	112
8.1.1	The magnitude system	112
8.1.2	Calculations with magnitudes	112
8.1.3	Telescope magnitude limits	113
8.1.4	Magnitudes in old books	114
8.2	Number of stars in the sky	114
8.3	Distances of the stars	115
8.3.1	Distance units	115
8.3.2	Parallax	116
8.3.3	Measuring greater distances	116
8.3.4	Absolute magnitude	117
8.4	Colors and spectra	117
8.4.1	Star colors	117
8.4.2	B and V magnitudes; color index	118
8.4.3	Spectroscopy	119
8.5	Stellar physics	120
8.5.1	Mass, luminosity, and temperature	120
8.5.2	Stellar evolution in brief	120
8.5.3	More about stellar evolution	121
9	Double and multiple stars	123
9.1	The importance of double stars	123
9.2	Position angle and separation	124
9.3	Binary-star orbits	125
9.4	Telescope limits	127
9.5	Making measurements for yourself	128
9.5.1	The need for measurements	128

Contents

9.5.2	Teague's reticle method	128
9.5.3	Calibrating the linear scale	129
9.5.4	Taking a measurement	129
9.5.5	Turning off the drive motors	130
9.6	Multiple-star nomenclature and catalogues	130
10	Variable stars	132
10.1	Overview	132
10.2	Types of variables	132
10.2.1	Pulsating variables	132
10.2.2	Irregular variables	134
10.2.3	Eclipsing binaries	134
10.2.4	Novae	135
10.2.5	Reporting a discovery	136
10.3	Nomenclature	137
10.3.1	Letter designations	137
10.3.2	Harvard designations	137
10.3.3	GCVS numbers	138
10.4	Observing techniques	140
10.4.1	Estimating magnitudes	140
10.4.2	Telescope considerations	142
10.4.3	Sources of difficulty	142
10.4.4	Photographic observation	143
11	Clusters, nebulae, and galaxies	144
11.1	The lure of the deep sky	144
11.2	Deep-sky objects	144
11.2.1	Asterisms	144
11.2.2	Open clusters	145
11.2.3	Nebulae	145
11.2.4	Our galactic neighborhood	146
11.2.5	Distant galaxies	146
11.2.6	Active galaxies and quasars	147
11.3	Observing techniques	148
11.3.1	Star clusters	148
11.3.2	Bright nebulae	148
11.3.3	"Faint fuzzies"	149
11.3.4	Magnitude and surface brightness	149
11.4	Catalogues and designations	150
11.4.1	The Messier (M) catalogue	150
11.4.2	The Caldwell Catalogue	154
11.4.3	The Herschel (H) Catalogue	158
11.4.4	NGC, IC, RNGC, and CNGC	158
11.4.5	Other important catalogues	161

Contents

11.5	Handbooks, classic and modern	161
11.5.1	<i>Smyth's Cycle of Celestial Objects</i>	161
11.5.2	<i>Webb's Celestial Objects for Common Telescopes</i>	162
11.5.3	Hartung and Burnham	162
11.5.4	Modern handbooks	164
Part II	200 interesting stars and deep-sky objects	165
12	How these objects were chosen	167
13	The January–February sky (R.A. 6 ^h –10 ^h)	171
14	The March–April sky (R.A. 10 ^h –14 ^h)	183
15	The May–June sky (R.A. 14 ^h –18 ^h)	197
16	The July–August sky (R.A. 18 ^h –22 ^h)	205
17	The September–October sky (R.A. 22 ^h –2 ^h)	223
18	The November–December sky (R.A. 2 ^h –6 ^h)	235
Appendices		
A	Converting decimal minutes to seconds	248
B	Precession from 1950 to 2000	249
C	Julian date, 2001–2015	252
	Index	255