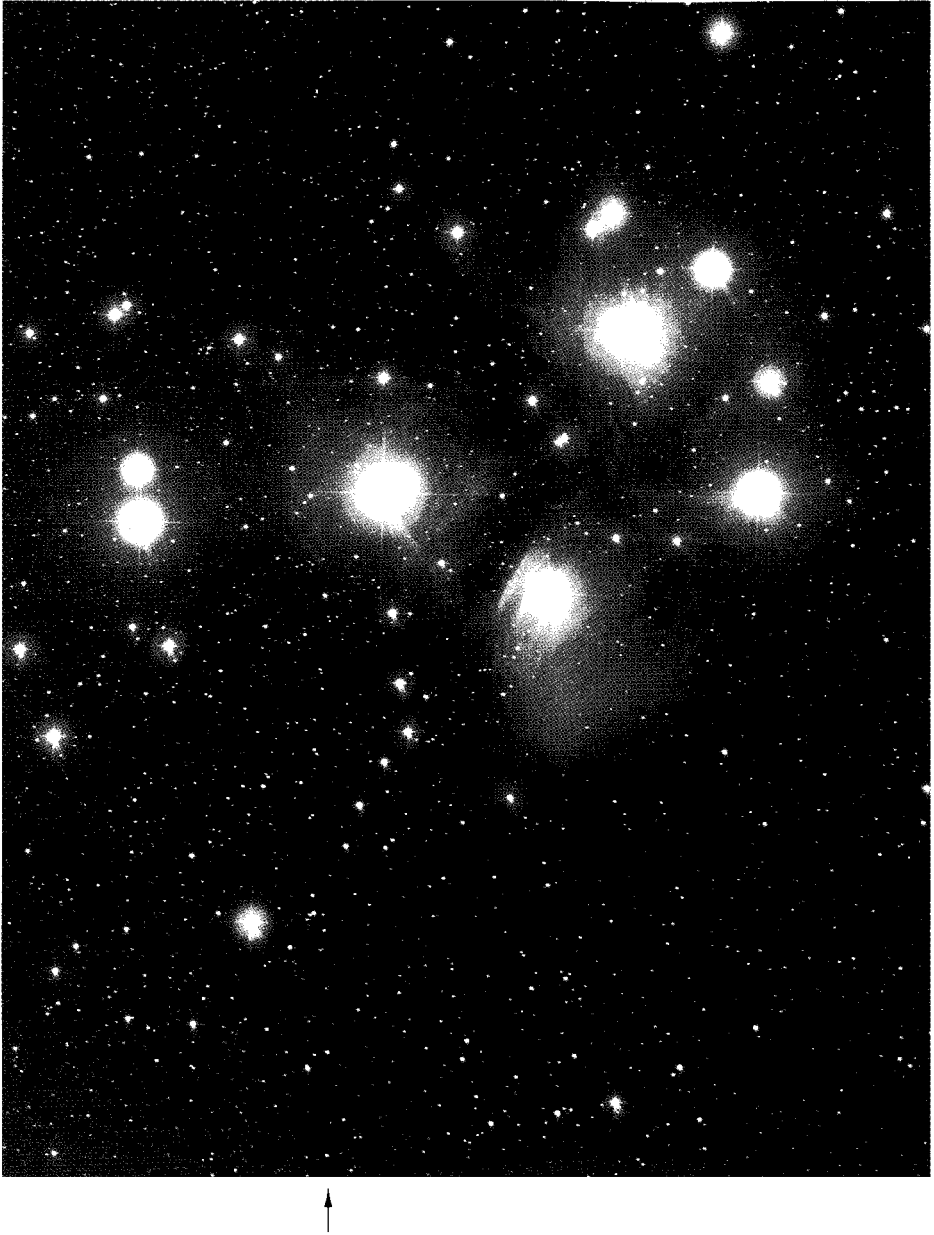


## David Levy's Guide to the Night Sky

The perfect introduction for the novice astronomer, this book stirs the imagination and puts observation in a framework of social activity and personal adventure. Written by an award-winning astronomer, it is a technical guide to the sky, full of helpful practical hints. The author's lively style engages, entertains, and informs. Newcomers will learn how to enjoy the Moon, planets, comets, meteors, and distant galaxies observable through a small telescope. Levy describes the features of the Moon from night to night, how to observe constellations, how best to view the stars, nebulae, and galaxies, how to follow the planets on their annual trek among the constellations, how to map the sky, how to find a new comet; how to buy or even make a telescope, what to see in a month of lunar observations or a year of stellar observation, and much more.

David H. Levy, who lives in Arizona with his wife Wendee, has discovered 21 comets and has written 29 books. Levy is the science editor for *Parade* magazine, and won an Emmy in 1998.



The Pleiades, November 4, 1989, taken with the 18 inch Schmidt at Palomar by Eugene and Carolyn Shoemaker and David Levy. At the intersection of the two arrows is a short trail of a newly discovered asteroid, 1989 VA, found the previous night. This asteroid has one of the shortest orbits of any known object in the solar system, less than two thirds of a year.

Cambridge University Press  
0521797535 - David Levy's Guide to the Night Sky  
David H. Levy  
Frontmatter  
[More information](#)

---

# David Levy's Guide to the Night Sky

---

DAVID H. LEVY



CAMBRIDGE  
UNIVERSITY PRESS

Cambridge University Press  
0521797535 - David Levy's Guide to the Night Sky  
David H. Levy  
Frontmatter  
[More information](#)

---

CAMBRIDGE UNIVERSITY PRESS  
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press  
The Edinburgh Building, Cambridge CB2 2RU, UK

Published in the United States of America by Cambridge University Press, New York

[www.cambridge.org](http://www.cambridge.org)  
Information on this title: [www.cambridge.org/9780521797535](http://www.cambridge.org/9780521797535)

© Cambridge University Press 1991, 2001

This publication is in copyright. Subject to statutory exception  
and to the provisions of relevant collective licensing agreements,  
no reproduction of any part may take place without  
the written permission of Cambridge University Press.

First published as *The Sky: A User's Guide* 1991  
Paperback edition 1993  
Reprinted 1994, 1995, 1997, 1999  
This edition published 2001

*A catalogue record for this publication is available from the British Library*

ISBN-13 978-0-521-79753-5 paperback  
ISBN-10 0-521-79753-5 paperback

Transferred to digital printing 2006

Cambridge University Press  
0521797535 - David Levy's Guide to the Night Sky  
David H. Levy  
Frontmatter  
[More information](#)

---

*To our daughter, Nanette,  
our son-in-law, Mark,  
and our granddaughter, Summer,  
with love*

## CONTENTS

*Foreword by Wendee Wallach-Levy* xv  
*Preface to the first edition* xvii  
*Preface to this edition* xix  
*Acknowledgments* xxii

### Part 1 **Getting started**

#### **1 First night out** 1

- 1.1 Discover the sky 2
  - 1.1.1 Aspects of the sky 3
  - 1.1.2 Magnitudes 4
- 1.2 The Big Dipper key 4
- 1.3 The Milky Way 6
- 1.4 The planets 7
- 1.5 Celestial co-ordinates and measurements 7
- 1.6 The star charts 9
- 1.7 Starry, starry skies ... 26

#### **2 Without a telescope** 27

- 2.1 Lights 28
  - 2.1.1 Haloes 28
  - 2.1.2 Aurora borealis and australis 28
  - 2.1.3 Zodiacal light and Gegenschein 33
  - 2.1.4 Artificial satellites 34
- 2.2 The planets 34
- 2.3 Diversity of the stars 35
- 2.4 The Sun 37
- 2.5 The Moon 38
- 2.6 Mercury 38
- 2.7 Planets in daylight 38
- 2.8 Variable stars 40
- 2.9 Deep sky objects 41
- 2.10 Searching 42

viii Contents

**3 Meteors 43**

- 3.1 Showers 44
  - 3.1.1 Showers month by month 45
- 3.2 Observing procedure 50
  - 3.2.1 Single observer 50
  - 3.2.2 Group observing 51
  - 3.2.3 Hints 52
- 3.3 Fireballs 54

**4 Choosing a telescope 55**

- 4.1 Binoculars 57
  - 4.1.1 Anticipating problems 58
- 4.2 Telescopes 59
  - 4.2.1 Refractor 59
  - 4.2.2 Reflector 61
  - 4.2.3 Compound telescopes 61
- 4.3 Eyepieces 61
- 4.4 Mounts 62
- 4.5 Why not make your own? 62
- 4.6 Extremes 64

**5 Telescopes, advanced 65**

- 5.1 How to use electronic telescopes 66

**6 Recording your observations 67**

Part 2 **Moon, Sun and planets**

**7 The Moon 73**

- 7.1 Why observe the Moon? 74
- 7.2 The phases 75
- 7.3 Training project 75
- 7.4 Day to day notes 77

**8 Moon II: advanced observations 86**

- 8.1 Crater drawing program 86
  - 8.1.1 Drawing a feature 86
  - 8.1.2 A note about notes 89
- 8.2 Photographing the Moon 89
  - 8.2.1 At the prime focus 91
- 8.3 Lunar transient phenomena 92
  - 8.3.1 Suspect areas 93
- 8.4 Notes on advanced projects 94
  - 8.4.1 Lunar height measurements 95
  - 8.4.2 Viewing difficult features 96

**9 The Sun 97**

- 9.1 Observing the Sun is dangerous 99

- 9.2 Observing projects 101
  - 9.2.1 Daily sunspot count 101
- 9.3 Other features on the Sun 106
  - 9.3.1 Disk drawings 106
  - 9.3.2 Detailed drawings 108
  - 9.3.3 Photographs 109
- 9.4 Advanced work: hydrogen-alpha filters 110
- 10 Jupiter 110**
  - 10.1 Jupiter and its moons 111
  - 10.2 Seeing 111
  - 10.3 The face of Jupiter 113
  - 10.4 Drawing Jupiter 114
    - 10.4.1 Full disk drawings 115
    - 10.4.2 Specific regions 116
  - 10.5 The Galilean satellites 119
  - 10.6 A comet strikes Jupiter 119
- 11 Saturn 123**
  - 11.1 Historical perspective 124
  - 11.2 The rings 124
  - 11.3 The globe 125
  - 11.4 Drawing Saturn 126
    - 11.4.1 A cloudy night experiment for clubs 126
    - 11.4.2 Actual drawing 127
    - 11.4.3 Estimating conspicuousness 127
  - 11.5 Estimating intensity 127
  - 11.6 The moons 129
    - 11.6.1 Titan 129
    - 11.6.2 Iapetus 130
    - 11.6.3 Phoebe 130
- 12 Mars 131**
  - 12.1 Observing Mars 133
  - 12.2 Drawing Mars 135
  - 12.3 Kinds of changes to expect 136
  - 12.4 Surface features 137
    - 12.4.1 The atmosphere 140
  - 12.5 Phobos and Deimos 141
  - 12.6 Mars thought 143
  - 12.7 The retrograde motion of Mars, by Leo Enright 143
- 13 Five planets worth watching 149**
  - 13.1 Venus 149
    - 13.1.1 Observing Venus 150
    - 13.1.2 Advanced observing 150
    - 13.1.3 Ashen light 152
    - 13.1.4 Transits 152



x Contents

- 13.2 Mercury 153
  - 13.2.1 Observing Mercury 153
- 13.3 How the outer planets were discovered 154
  - 13.3.1 Discovery I: Uranus 154
  - 13.3.2 Discovery II: Neptune 155
  - 13.3.3 Discovery III: Pluto 157
- 13.4 Observing Uranus 158
- 13.5 Observing Neptune 160
- 13.6 Observing Pluto 160

Part 3 **Minor bodies**

14 **Asteroids** 163

- 14.1 Historical perspective 163
- 14.2 Naming of asteroids 165
- 14.3 Observing asteroids 166
- 14.4 Kinds of asteroids 166
- 14.5 Observing asteroids 166
  - 14.5.1 A life list of asteroids 167
- 14.6 Asteroid occultations 167
- 14.7 Physical observations 170
  - 14.7.1 A photometric study of some asteroids 170

15 **Comets** 172

- 15.1 Comets, clouds, and variable stars 172
- 15.2 Comet observers 174
- 15.3 What is a comet? 175
- 15.4 Families of comets 175
- 15.5 Groups of comets 175
- 15.6 Observing comets 176
  - 15.6.1 How to estimate the brightness of a comet 177
- 15.7 The coma 179
- 15.8 Comet hunting 180
- 15.9 Procedures for hunting 182
  - 15.9.1 Sun vicinity 183
  - 15.9.2 Twilight horizon 183
  - 15.9.3 A group search program 183
- 15.10 Hunting with a telescope 184
  - 15.10.1 Search procedures 184
- 15.11 Appropriate times 185
- 15.12 Discovery 186
- 15.13 The naming of comets 188

## Part 4 **Deep sky**

### 16 **Double stars** 191

- 16.1 Mizar 191
- 16.2 Historical notes 192
- 16.3 Nature of doubles 193
- 16.4 Observing double stars 194
  - 16.4.1 Recording your observations 195
  - 16.4.2 Doubles as optical tests 196
  - 16.4.3 The Tombaugh–Smith seeing scale 196
- 16.5 Advanced work 198

### 17 **Variable stars** 199

- 17.1 The AAVSO 200
- 17.2 Eclipsing binaries 201
- 17.3 Cepheids 202
- 17.4 Long period stars 202
- 17.5 Semiregular stars 203
- 17.6 Cataclysmic variables 206
- 17.7 T Tauri 207
- 17.8 Naming of variables 207
- 17.9 How to observe a variable star 208
- 17.10 Suggested frequency of observation 210
- 17.11 Northern summer program 210
- 17.12 Northern winter program 211
- 17.13 A selection of variable stars 211
- 17.14 Searching for novae and supernovae 216
- 17.15 Neutron star song 222

### 18 **TV Corvi: A variable star adventure** 223

### 19 **The deep sky** 225

- 19.1 *The New General Catalogue* 226
- 19.2 Open clusters 226
- 19.3 Globular clusters 229
- 19.4 Diffuse nebulae 232
- 19.5 Planetary nebulae 235
- 19.6 Supernova remnants 237
- 19.7 Galaxies 237
- 19.8 Quasars 238
- 19.9 Telescope and sky 239
- 19.10 For a city sky 239
- 19.11 For a dark sky 242

### 20 **Messier hunting** 245

- 20.1 Messier marathons 258

xii Contents

- 21 **The sky on film** 262
  - 21.1 Star trails 264
  - 21.2 The Sun 266
  - 21.3 Moon and planets 266
    - 21.3.1 Photographs by projection 266
  - 21.4 Guided astrophotography 267
    - 21.4.1 Camera support 267
    - 21.4.2 What you need 267
    - 21.4.3 Aligning the polar axis 269
    - 21.4.4 Setting up the picture 270
    - 21.4.5 Focusing 270
    - 21.4.6 Ready! 271
  - 21.5 Some advanced ideas 271
    - 21.5.1 Copying 271
    - 21.5.2 Hypersensitizing 271
  - 21.6 Processing film 272
  - 21.7 Some hints 273
- 22 **The electronic revolution, part 1: CCDs** 275
  - 22.1 Connecting a CCD to a computer 277
  - 22.2 Observing with CCDs 277
    - 22.2.1 Focusing 278
    - 22.2.2 Taking the image 278
    - 22.2.3 Flat fielding 279
    - 22.2.4 Image manipulation 279
- 23 **The electronic revolution, part 2: Astrometry** 280
  - 23.1 Some background 281
  - 23.2 Observing the object 282
  - 23.3 Measuring positions the classical way 282
  - 23.4 Using CCDs 283

Part 5 **Special events**

- 24 **Solar eclipses** 285
  - 24.1 Alignments 286
  - 24.2 Solar eclipses and the public 286
    - 24.2.1 Eye protection 287
  - 24.3 The saros cycle 289
  - 24.4 Partial eclipses 290
  - 24.5 Total eclipses 290
    - 24.5.1 Photographing a solar eclipse 291
  - 24.6 Other activities 293
  - 24.7 Annular eclipses 294
  - 24.8 Enjoy it! 295

**25 Lunar eclipses and occultations 295**

- 25.1 Lunar eclipses 296
  - 25.1.1 Shadows 296
  - 25.1.2 Things to do 297
  - 25.1.3 Penumbral eclipses 300
  - 25.1.4 Thought 300
- 25.2 Lunar occultations 301
  - 25.2.1 Grazing occultations 302
  - 25.2.2 Occultations of planets 304
  - 25.2.3 Occultations by planets 304
  - 25.2.4 Murphy's Law and occultations 304

**Part 6 A miscellany****26 Passing the torch 309**

- 26.0.1 Schools 309
- 26.1 Methods of teaching 310
- 26.2 The planets 310
- 26.3 Daytime observing 311
  - 26.3.1 Observing the Sun 312
  - 26.3.2 Venus 312
  - 26.3.3 Observing the Moon 313
- 26.4 Night observing 313
- 26.5 Meteors, and learning through research 314
- 26.6 Closing thought 314

**27 The poet's sky 318****28 My favorite objects 323**

- 28.1 The Moon 323
- 28.2 The Sun 324
- 28.3 Jupiter 324
- 28.4 Saturn 324
- 28.5 Algol 325
- 28.6 V Hydrae 325
- 28.7 TV Corvi 326
- 28.8 47 Ursae Majoris 326
- 28.9 Wendee's star 326
- 28.10 Eta Carinae 327
- 28.11 Wendee's Ring 327
- 28.12 Equuleus S 328
- 28.13 IC 1396 328
- 28.14 NGC 1931 328
- 28.15 M17: The Omega Nebula 329
- 28.16 Messier 31 329

xiv Contents

- 28.17 Messier 51: The Whirlpool Galaxy 329
- 28.18 NGC3621: The Frame Galaxy 330
- 28.19 The Hydra Trio: Larry, Mo and Curly 330
- 28.20 Nanette's River 330

**Appendix: Resources 331**

- Societies 331
  - Lunar and planetary 331
  - Variable stars 331
  - Occultations 331
  - Photometry 332
  - Deep sky 332
  - Light pollution 332
  - Sun 332
  - Three other organizations 333
- Literature 333
  - Observing assistance 333
  - Star atlases 334
  - Historical 334
  - Solar system 335
  - Deep sky 335
  - General assistance 336
  - For children 336
  - Magazines 336

**Index 339**

## FOREWORD

I have always loved simply looking up at the night sky. It didn't matter that I didn't know the names of any stars, and that I could only find three constellations – Ursa Major, Orion, and Cassiopeia. As far as I knew there weren't any others! I did, however, know that there was a Little Dipper, but could never find it. I still have trouble finding it, even though I now know exactly where it is.

Each night when David and I go into our observatory to do our photographic comet hunt, I look forward to three things. The first is taking my first step off of our back porch, because the sky simply unfolds for me right there. It is so black and filled with stars that even Orion becomes lost in the sea of stars. My reaction is always the same: 'Oh my! I love my sky.' I try to share that experience with everyone who visits us. As soon as they take their first step off of our porch, I have them stop and just look up.

The second thing is that I love having the luxury of David as my own personal tutor. Having this book as your companion is almost like having David by your side. Through it, you can ask him questions over and over, as I do, and he'll always answer you.

The third thing I look forward to is scrambling around in the dark, loading and unloading the film holder and helping David get started with his guiding the telescope for whatever star field we are photographing as a part of our search for comets. The evenings when comet discoverer Carolyn Shoemaker observes with us are that much more fun because as we work, we always ask David more questions about the stars and the night sky.

*The Sky: A User's Guide* takes you step by step into a world that most of us can only see from below and wonder about. I hope you have as much fun as I do learning about the sky through its pages.

*Wendee Wallach-Levy*

## PREFACE TO THE SKY: A USER'S GUIDE

This is your owner's manual for the sky. Do you know how, when you buy a new product, the instructions often begin by congratulating you on purchasing it? In a sense, you have purchased your interest in astronomy as an article of faith, hoping that by joining a club, subscribing to a magazine, or buying a book like this one, your hours under the stars will be beneficial. So, congratulations! You have above you the only brand of sky in town, and I hope you enjoy it.

Designed to give you a sense of what observing *as an amateur* is all about, this book provides a set of observing suggestions for a number of the many fields of observing. Every area offers complexity and challenge, but in different forms. There are at least two particular ways to observe 'stars', for example. Variable star observing offers greater scientific reward for an amateur than does double star observing, but each field takes time and patience to develop, and I think that both are equally fun.

If you are interested in observing only to help the professionals, you may be in amateur astronomy for the wrong reason. The first rule of observing is that it be satisfying. For the most part, professionals are not greatly interested in our work, although good observations in any area might attract their attention.

Observational astronomy offers something for everyone. Each observing discipline has its own code of requirements, both scientific and social, and you should be able to find one that closely matches your interests and temperament. For example, meteor shower observing is often done in groups of six or more to ensure adequate coverage of the entire sky. This encourages meteor shower 'parties' that can last all night long, leaving the participants intoxicated, as it were, with meteoric dust. Eclipses also are fine gatherers of astronomy enthusiasts, as observers like to share the awesome moments of these celestial line-ups.

Where meteor observing ought to be the grand excuse for an ultimate celestial party, comet hunting is a loner's pursuit. Rather competitive, it is

xviii Preface to The Sky: A User's Guide

almost always done by an observer working alone. The person who leaves a snug bed for a 3 a.m. look at Mars, because that is when Mars is highest in the sky and thus most clearly seen, enjoys a special communion with a planet that is not quite the same when a crowd of sightseeing stargazers congregate nearby.

This book is designed to suggest enjoyable areas of observation. It is slightly weighted toward solar system observation, since objects in this region are most easily seen from the urban locations most beginners observe from. Not a textbook, its facts relate directly to your observing needs. Here you will pick up ideas on how and what to observe; this book guides you into more productive and happy use of your observing time. But these are just ideas; later you might come up with original projects to make your observing time even more interesting. Whether for socializing or for science, observing is an activity that can rapidly become your outlet to relax and to become involved in a fascinating avocation.

Each part of this book has been organized according to how easy or difficult objects are to observe. The planets, for example, begin with Jupiter and progress through the objects which, through brightness or times of visibility, are not as easy to watch on a regular basis.

When you buy something, you expect a guarantee. There is none for the sky. Some once-active observers I know have lost their enthusiasm for observing, and I must admit that in the 8200 times I have been under the stars, there were two or three times when I was not overwhelmed with what I saw. You may lose interest; many do. I do hope that your interest lasts, that it is strong and satisfying, and that you do your best to spread it to someone else.

Amateur astronomy is not just a hobby, it is a commitment, a way of life that transcends the detail of daily existence. Look through your telescope thoughtfully tonight, for it is more than starlight that its mirror will reflect. From the unknown dimensions of space and time will return also a part of yourself.



## PREFACE TO THIS EDITION

More than a decade ago, I thought of writing an 'owner's manual' to the night sky that I love. The result was *The Sky: A User's Guide*, a book that has since seen four printings in two languages. I hope that its many readers have used it to appreciate the beauty, inspiration, and fun of the night sky.

A lot has happened up there, and down here, in 13 years. While the Hubble Space Telescope has given us spectacular new views of the heavens, the real change for new observers of the night sky comes in the small computer-controlled electronic telescopes. I would never have expected it: After observing the night sky for almost 40 years, I tried one of these new telescopes and found that it opened a whole new world – or sky – for me. After a few easy steps, my new telescope not only found the 'Spindle Galaxy' for me, but it also told me that the galaxy is 27 million light years away, and that there might be a black hole at its center. No longer was I looking at a mere speck of distant, fuzzy light. Now I could read the celestial resume of each new object I saw.

*The Sky: A User's Guide* was written originally to answer the first question of anyone who has just joined an astronomy club: 'Okay; I've paid my dues, what do I do now?' This book explores the observing programs offered by many astronomy clubs, and guides your way to doing some useful, and enjoyable, observing of everything from the solar system to distant quasars.

All this is based on an idea. When I first joined the Montreal Center of the Royal Astronomical Society of Canada, I thought that all I was going to do was to look up at the Moon and stars. But it didn't quite happen that way. I walked in the observatory's front door and was promptly met by Isabel K. Williamson, who promptly gave me a map of the Moon with 300 craters, all numbered and named, and 26 mountain ranges, valleys, and other features conveniently lettered A through Z. One does not just look at the sky, I learned, one sketches, times, or photographs the sky to enhance the experience. For a 12 year old, mapping the Moon was quite a homework assignment, but I loved every minute of the three years I took to complete the exercise. I made my own lunar

xx Preface to this edition

map, and as I identified a crater, I would plot it on that map. By the time I finished, the Moon and I had begun a friendship that has never waned.

The Moon is so exciting because it is close. At only 240 000 miles away, the Moon is a place that you can visit through a small telescope. During my mapping project I felt as though I was actually flying over mountain ranges and into craters. And as the Sun rises over a crater, the shadows shortened, allowing the crater's details to change over a period of a few hours or a day. After my experience with the Moon, I looked forward to seeing the more subtle details on the planets. They are farther away, so I knew I was looking for features that might be difficult to detect. Mars was supposed to be the easiest planet, but for me it was not. I first set up my scope to look at Mars while I was a patient at the Jewish National Home for Asthmatic Children. Anxious to find a good site that blocked out the street lights on February 2, 1963, the night of Mars's closest approach to Earth in the previous two years, I carefully set up the telescope using the wall of the girls' dormitory to shield a nearby street light. Mars was nowhere near as close as it can get to Earth, so the details on the planet that chilly winter evening were difficult to detect through my small telescope. When I explained to my houseparent my lack of success, he accused me of using the telescope to spy on the girls!

A year later – now back at home in Montreal – my friend Carl Jorgensen got me interested in looking at double stars. They're easy to find in the sky, he maintained, and they can be often observed through the city's light pollution. If the two stars of the pair have different colors, the contrast is often very beautiful to watch. Early in 1966, I was introduced to variable stars, stars that actually perform from night to night. Variable stars change brightness according to schedules that typically run from a few days to several months, and watching those changes is a fascinating way to spend an evening.

Going out beyond the stars can be a moving experience. So many people cross the galaxy each week by watching *Star Trek* or some other science fiction program, and sit in their living rooms wondering if we'll ever be able to travel at warp speed. Truth? By looking through your telescope, you can travel through space as far and as fast as you like, visiting not just stars in our galaxy but clusters at the galaxy's edge, and very distant external galaxies also. Did you know that your own eye, without a telescope, should be able to peer out some two million light years into space? And with a telescope, seeing galaxies ten to twenty million light years away is easy.

Astronomy can be an absolutely delightful hobby. It began that way for me, but it quickly turned into a passion that has enriched my life. Most important, the objects I have seen in space all these years have become very personal to me. When I first looked at Jupiter in the summer of 1960, I had no idea that a comet

that I would help discover years later was at that moment orbiting the giant planet, and that in 1994 it would collide with Jupiter, producing some of the most spectacular explosions the solar system can offer. Nor did I know that the same Moon that would provide so many childhood fun evenings would, in 1999, become the final resting place of my friend Gene Shoemaker. With events like these, my astronomical experience cannot help but be very personal, and I suspect that in your own way, you will find your own experience to be just as meaningful. With that as a hope, let's open the front door, step outdoors, and look up at the sky.

## ACKNOWLEDGMENTS

To Stephen J. Edberg, for his thorough review of every word of the manuscript, and to his son, Aaron, I am in great debt. Steve took the time to read two or more drafts of several chapters.

Walter Haas, founder of the Association of Lunar and Planetary Observers, offered general advice. John Westfall, Director of the ALPO, reviewed the two Moon chapters and the material on eclipses. Gary Rosenbaum examined the Mars chapter; Rik Hill evaluated the Sun chapter; and Dolores Hill made many suggestions on the meteors chapter. Charles Morris and Jean Mueller were most helpful.

Larry Stein, Richard Levy and Peter Jedicke read through the introductory chapters. Derald Nye evaluated the material on occultations; Paul Lorenz gave advice on the deep sky chapter; Judy Stowell typed early versions of the manuscript; and Lonny Baker thoroughly reviewed the solar eclipse chapter. Peter Jedicke prepared the index.

Parts of Chapter 23 were adapted from the first two chapters of my 1979 Queen's University M.A. Thesis, 'The Starlight Night: Hopkins and Astronomy'; an article 'Poet and observer: Gerard Manley Hopkins and some mid-19th century comets' in *The Journal of the Royal Astronomical Society of Canada*, vol. 75, no. 3, 1981; and my 'Observer's Cage' column in the October, 1986, National Newsletter of the RASC. I thank Norman MacKenzie of Queen's University for his inspiration and help with the material that appears in this chapter. Simon Mitton and Cambridge University Press were very friendly and helpful through every stage of the process of the book's publication. I thank the editors of *Sky and Telescope* magazine for their assistance with Chapter 28, a different version of which appeared in the magazine's April 2001 issue. I also thank my wife Wendee, whose help included the preparation of the index.

I am thoroughly indebted to all these people for their time and effort to help make this a thorough and accurate observing book.