CHAPTER 1
About this book

Seeing is in some respects an art that must be learnt. — William Herschel

EVERY MOMENT SPENT under the stars is a treasure hunt – a visual journey that leads us to endless riches in the heavens above. And I've loved each adventure from the beginning. When I was young, perhaps age eight, I set out on one of my first deep-sky adventures – to hunt down the great globular cluster M13 in Hercules. I had seen a full-page photo of it in *Planets, Stars, and Space* (first published in 1957 by Creative Educational Society in cooperation with the American Museum of Natural History, New York), which my father kept on the lower shelf of a bookcase set up in the living room. The book's authors, Joseph Miles Chamberlain and Thomas D. Nicholson, described the cluster as a "huge ball of stars . . . so numerous that the center . . . resembled a brilliant mass of light." My Golden Guide, *The Sky Observer's Guide*, went one step further, saying that this "globular may have 100,000 [stars]." It also said it may be seen with the naked eye.

It seemed incredible to me at the time that if I could first find the Keystone of Hercules among the multitude of stars overhead, I could then search for a citadel of 100,000 suns – one so distant and so tightly packed together (yet so bright) that I could see it with the naked eye as a hazy star.

I was still learning the constellations at the time, so I had to be certain that I had the right keystone. The search was glamorous in itself, because it made me feel the thrill of voyage. I was a flesh-and-blood Jim Hawkins (the protagonist in Robert Louis Stevenson's *Treasure Island*) in search of "buried" cache.

When I finally convinced myself that I had the right keystone, I could scarce believe that the dim smudge I was seeing was the great cluster. So I dashed inside the house, grabbed my father's binoculars, and returned to the chill of the night. After a few minutes of letting my eyes readjust to the darkness, I set out again to search for the keystone. This time, when I spied it, and the little smudge within, I raised the binoculars to the spot and began "bobbing" for the cluster – I was still learning how to use binoculars, so they were quite unsteady. It took a while, but in time I saw a globe of white light flash through the field of view. I narrowed my bobs until I held the object steady. The cluster was small, misty, and round. I saw no teeming masses of suns, no glints of scintillating starlight, just a tiny cloud of light. But I was not disappointed. To a kid just beginning to fathom the universe, the mist of M13 was one of the most majestic sights

imaginable. The wonder, it turned out, was not so much finding it, but beholding it, imagining it in ways my eyes could not see.

I've never lost that childhood wonder. In fact, that same fascination guided me in the making of this book.

THE TELESCOPE AND SITE

All the observations for this book were made from the Big Island of Hawaii, where I live. My observing site is near the 4,200-foot-high summit of Kilauea, a gently sloping shield volcano that has been in near-continuous eruption since January 1983. This is the same general area (as the Hawaiian hoary bat flies) where I made the observations for *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*. But after the latter title was published, I decided to change my observing site because tourist traffic was becoming a nuisance. My new site is more secluded, so I observe fewer car headlights through my old Tele Vue 4-inch f/5 Genesis refractor. Since clouds could blow in unexpectedly at any time, I needed to be migratory; on occasion I had to drive a few thousand feet to get above the clouds to observe a hidden treasure. The photograph above is an aerial shot showing the summit area of Kilauea volcano where the observations were made. The circular depression near the middle of this frame is the summit crater of Kilauea, called Halemaumau, which spans 1000 feet (305 meters).

After I completed the observations for *Deep-Sky Companions: The Caldwell Objects*, I called Tele Vue founder, Al Nagler, and asked if his company could, once again, clean up an old friend. (If you've read *Deep-Sky Companions: The Caldwell Objects*, you'll know that after four years of exposure to the acidic gases escaping from Kilauea volcano, I had to have the telescope's optics cleaned, which, when Nagler saw them, almost caused him to faint.) After a long moment of silence – the kind one expects when asked to pray for the loss of a loved one – Al conceded to operate. I got my Genesis back, this time with a

card from the optician who wondered if there was any way, in the future, I could not place the telescope in the direct path of any sulfuric acid clouds. I promised to try.

For the *Hidden Treasures* project, I used three eyepieces (also made by Tele Vue): a 22-mm Panoptic, a 7-mm Nagler, and a 4.8-mm Nagler. On the Genesis these eyepieces provide magnifications of 23×, 72×, and 105×, respectively. A 1.8× Barlow lens gave me additional magnifications of 41×, 130×, and 189×, while a 3× Barlow gave me high powers of 216× and 315×. In addition, I now own a Nagler 3–6-mm zoom eyepiece, which when used together with my Barlow lenses offers me a wide variety of magnifications ranging from 84× to 504×. As a finder I use a Tele Vue Qwik Point (it's like a laser pointer). The Genesis offers me a field of view near 3° wide when I use the 22-mm Panoptic. The telescope sits in the cradle of a sturdy Gibraltar mount, and the entire set up can be broken down in two minutes in case I need to be mobile.

In addition to the Tele Vue 4-inch, I also used a beautiful nineteenth-century brass telescope made by Ross of London. It was a Christmas present from my wife, Donna, who bought it while we were in South Africa during a solar-eclipse cruise in December 2002. I was, at the time, visiting the site where John Herschel had made his great survey of the southern sky, and Donna was off exploring the Capetown area. That's when she found an antique shop and this brass telescope, which I simply refer to as "the antique telescope" in Chapter 2. The tube measures $17\frac{1}{8}$ inches when open, and $7\frac{1}{4}$ inches when closed. The $1\frac{3}{4}$-inch objective is in excellent condition. I found the views through it enlightening. I observed many of the hidden treasures with this telescope. Doing so made me appreciate the views of our astronomical ancestors, especially Caroline Herschel who made her first sweeps of the skies in 1783 with a telescope very similar to this one.

HOW TO USE THIS BOOK

To find a hidden treasure, first locate the object's position on the wide-field finder chart that opens each entry. In keeping with the book's theme of hidden treasure, "X" marks the spot; actually "HT X" marks the spot. (Note that the "X" will most likely not be centered on the map, so you have to hunt a bit to locate it among the stars.) Take note of the brightest stars (those with Greek letters or Flamsteed numbers) near your hidden treasure. Next, locate those stars on the detailed finder chart that accompanies the object's photograph and text (like the wide-field finder chart, the detailed finder charts are oriented with north up and west to the right). Finally, find the part of the text that describes how to locate the object and simply follow the directions.

After the full-page wide-field finder chart, each object's entry in Chapter 2 opens with a photograph of the object (oriented with north up and west to the right, unless otherwise noted) and a list of essential data: hidden treasure number; common name(s), if any; object type; constellation; equinox 2000.0 coordinates; apparent magnitude; angular size or dimensions; surface brightness in magnitudes per square arcminute (for galaxies); distance; and the object's discoverer and discovery date. The text includes a history of the object's discovery; recent research findings; naked-eye or binocular impressions; the object's appearance through the 4-inch Genesis refractor at various magnifications; descriptions by other observers using larger instruments; a visual challenge or two; and brief notes on any interesting objects in the same region of sky.

A "drawing" also accompanies the text, so you can compare your view of any hidden treasure with my own. The views may be very dissimilar, but that's okay; we all see things differently.

You'll find William Herschel's original published description of the object or, if William did not observe the object, his son John's. If neither observer discovered or observed the object, that section is blank. Larry Mitchell, a member of the Houston Astronomical Society, supplied me with William's original notes, which he drew from his original catalogs as they appeared in the *Philosophical Transactions* of the Royal Society of England.

John Herschel's quotations have been gleaned from those given by the "Deepsky Observer's Companion" (www.fortunecity.com/roswell/borley/49/), which was created by the Astronomical Society of South Africa to promote its Deepsky Observing section. The quotes are from John Herschel's original observations, published in 1847 as "results of Astronomical Observations made during the years 1834, 5, 6, 7 [and] 8, at the Cape of Good Hope; Being the completion of a telescopic survey of the whole surface of the visible heavens, commenced in 1825." During his stay in South Africa, John Herschel often made several observations of each object. The quotes used in this book's tables, however, refer only to his first observation; a date is given only if the junior Herschel discovered the object. At the end of each Herschel description is a code contained in parentheses ("H I-156," for instance, or "h 242"). This code dates to a classification system created and used by the Herschels. "H" stands for the elder Herschel and "h" for his son.

The Roman numeral in William Herschel's system identifies the class into which he placed each object:

I. Bright nebulae
II. Faint nebulae
III. Very faint nebulae
IV. Planetary nebulae: stars with burs, with milky chevelure, with short rays, remarkable shapes, etc.
V. Very large nebulae
VI. Very compressed and rich clusters of stars
VII. Pretty much compressed clusters of large or small stars
VIII. Coarsely scattered clusters of stars

The Arabic numeral that follows is simply the order in which that object appears in that class. So H I-156 is the 156th object in Herschel Class I (bright nebulae).

The original 1888 *New General Catalogue* (*NGC*) description, or a description from the supplemental *Index Catalogues*, follows each Herschel description.

SOURCES OF DATA AND INFORMATION

The data and information in this book were drawn from a variety of modern sources. Many of these sources were used in *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*, so you can compare the properties of the respective catalogs' objects with confidence. Generally speaking, recent research findings on the physical nature of these objects were gleaned from the *Astronomical Journal* or the *Astrophysical Journal*; citations are frequently given. From each object's apparent diameter and distance, I calculated its physical dimensions using the formulas that appear on p. 35 of *Deep-Sky Companions: The Messier Objects*. Other information, such as constellation lore; properties of stars; and object's positions, apparent magnitudes, angular sizes, and surface brightnesses, come from the following excellent sources (primary sources are listed first).

Star names, constellations, and mythology

Allen, Richard Hinckly. *Star Names: Their Lore and Meaning.* New York: Dover Publications, 1963.

Staal, Julius D. W. *The New Patterns in the Sky: Myths and Legends of the Stars.* Blacksburg, VA: McDonald and Woodward, 1988.

Motz, Lloyd and Carol Nathanson. *The Constellations: An Enthusiast's Guide to the Night Sky.* New York: Doubleday, 1988.

Ridpath, Ian. *Star Tales*. New York: Universe Books, 1988.

Stellar magnitudes and spectra

Hirshfeld, Alan, Roger W. Sinnott, and Francois Ochsenbein, eds., *Sky Catalogue 2000.0*, Vol. 1, 2nd edn. Cambridge: Cambridge University Press/Cambridge, MA: Sky Publishing Corp., 1991.

CDS. *SIMBAD* (*Set of Identifications, Measurements, and Bibliography for Astronomical Data*). Strasbourg, France: Centre de Donnees Astronomiques de Strasbourg, http://simbad.u-strasbg.fr/ and http://simbad. harvard.edu/.

Stellar distances

ESA. *The Hipparcos and Tycho Catalogues.* Noordwijk, The Netherlands: European Space Agency, 1997.

Double stars

USNO. *The Washington Double Star Catalog.* Washington, DC: Astrometry

Department, US Naval Observatory, http://ad.usno.navy.mil/ad/wds/wds.html.

Couteau, Paul. *Observing Visual Double Stars*. Cambridge, MA: MIT Press, 1982.

Hirshfeld, Alan and Roger W. Sinnott, eds., *Sky Catalogue 2000.0*, Vol. 2. Cambridge, MA: Sky Publishing Corp./Cambridge: Cambridge University Press, 1985.

Luginbuhl, Christian B. and Brian A. Skiff. *Observing Handbook and Catalogue of Deep-Sky Objects*. Cambridge: Cambridge University Press, 1989.

Variable stars

Hirshfeld, Alan and Roger W. Sinnott, eds., *Sky Catalogue 2000.0*, Vol. 2. Cambridge, MA: Sky Publishing Corp./Cambridge: Cambridge University Press, 1985.

Luginbuhl, Christian B. and Brian A. Skiff. *Observing Handbook and Catalogue of Deep-Sky Objects*. Cambridge: Cambridge University Press, 1989.

American Association of Variable Star Observers, http://www.aavso.org/.

Levy, David. *Observing Variable Stars: A Guide for the Beginner.* Cambridge: Cambridge University Press, 1998.

Open star clusters

Archinal, Brent A. and Steven J. Hynes. *Star Clusters.* Richmond, VA: Willmann-Bell, Inc., 2000.

Globular star clusters

Harris, William E. *Catalog of Parameters for Milky Way Globular Clusters.* Hamilton, ON: McMaster University, http://physwww.physics.mcmaster.ca/%7Eharris/mwgc.dat *Star Clusters*.

Skiff, Brian A. Observational data for galactic globular clusters. *Webb Society Quarterly Journal* **99**: 7 (1995) updated May 2, 1999.

Planetary nebulae

Skiff, Brian A. Precise positions for the NGC/IC Planetary Nebulae. *Webb Society Quarterly Journal* **105**: 15 (1996). (See positions.)

Luginbuhl, Christian B. and Brian A. Skiff. *Observing Handbook and Catalogue of Deep-Sky Objects*. Cambridge: Cambridge University Press, 1989. (See dimensions and central star magnitudes.)

Cragin, Murray, James Lucyk, and Barry Rappaport. *The Deep-Sky Field Guide to Uranometria 2000.0*, 1st edn. Richmond, VA: Willmann-Bell, Inc., 1993.

Acker, Agnes and Francis Gleizes. *Catalogue of the Central Stars of True and Possible Planetary Nebulae*. Strasbourg: Observatory of Strasbourg, France, 1982.

Hynes, Steven J. *Planetary Nebulae: A Practical Guide and Handbook for Amateur Astronomers*. Richmond, VA: Willmann-Bell, Inc., 1991.

Planetary-nebula distances generally were gleaned from the professional literature or from the World Wide Web page of the Space Telescope Science Institute (www.stsci.edu).

Diffuse nebulae

Cragin, Murray, James Lucyk, and Barry Rappaport. *The Deep-Sky Field Guide to Uranometria 2000.0*, 1st edn. Richmond, VA: Willmann-Bell, Inc., 1993.

Hirshfeld, Alan and Roger W. Sinnott, eds., *Sky Catalogue 2000.0*, Vol. 2. Cambridge, MA: Sky Publishing Corp./Cambridge: Cambridge University Press, 1985.

Diffuse-nebula distances were gleaned from the professional literature.

Galaxies

Tully, R. Brent. *Nearby Galaxies Catalog*. Cambridge: Cambridge University Press, 1988. (See types, angular sizes, distances, masses, and luminosities.)

Cragin, Murray, James Lucyk, and Barry Rappaport. *The Deep-Sky Field Guide to Uranometria 2000.0*, 1st edn. Richmond, VA: Willmann-Bell, Inc., 1993. (See apparent magnitudes and surface brightness.)

NASA. *The Extragalactic Database*. Pasadena, CA: Infrared Processing and Analysis Center, http://nedwww.ipac.caltech.edu/. (See positions and, when not available from the above references, other parameters.)

Extragalactic supernovae

IAU. *List of Supernovae*. Cambridge, MA: Central Bureau for Astronomical Telegrams, http://cfa-www.harvard.edu/iau/lists/Supernovae.html.

Historical objects

Glyn Jones, Kenneth. *The Search for the Nebulae*. Bucks: Alpha Academic, 1975.

Information on pirates

Cordingly, David. *Under the Black Flag*: *The Romance and the Reality of Life Among the Pirates*. Orlando, FL: Harcourt Brace & Company, 1995.

Marine Research Society. *The Pirates' Own Book*: *Authentic Narratives of the Most Celebrated Sea Robbers*. New York: Dover Publications, 1993.

Note that the World Wide Web Uniform Reference Locators, or URLs, are subject to change. The dimensions, magnitudes, and positions of all other additional deep-sky objects in this book were taken from *The Deep-Sky Field Guide to Uranometria 2000.0*.

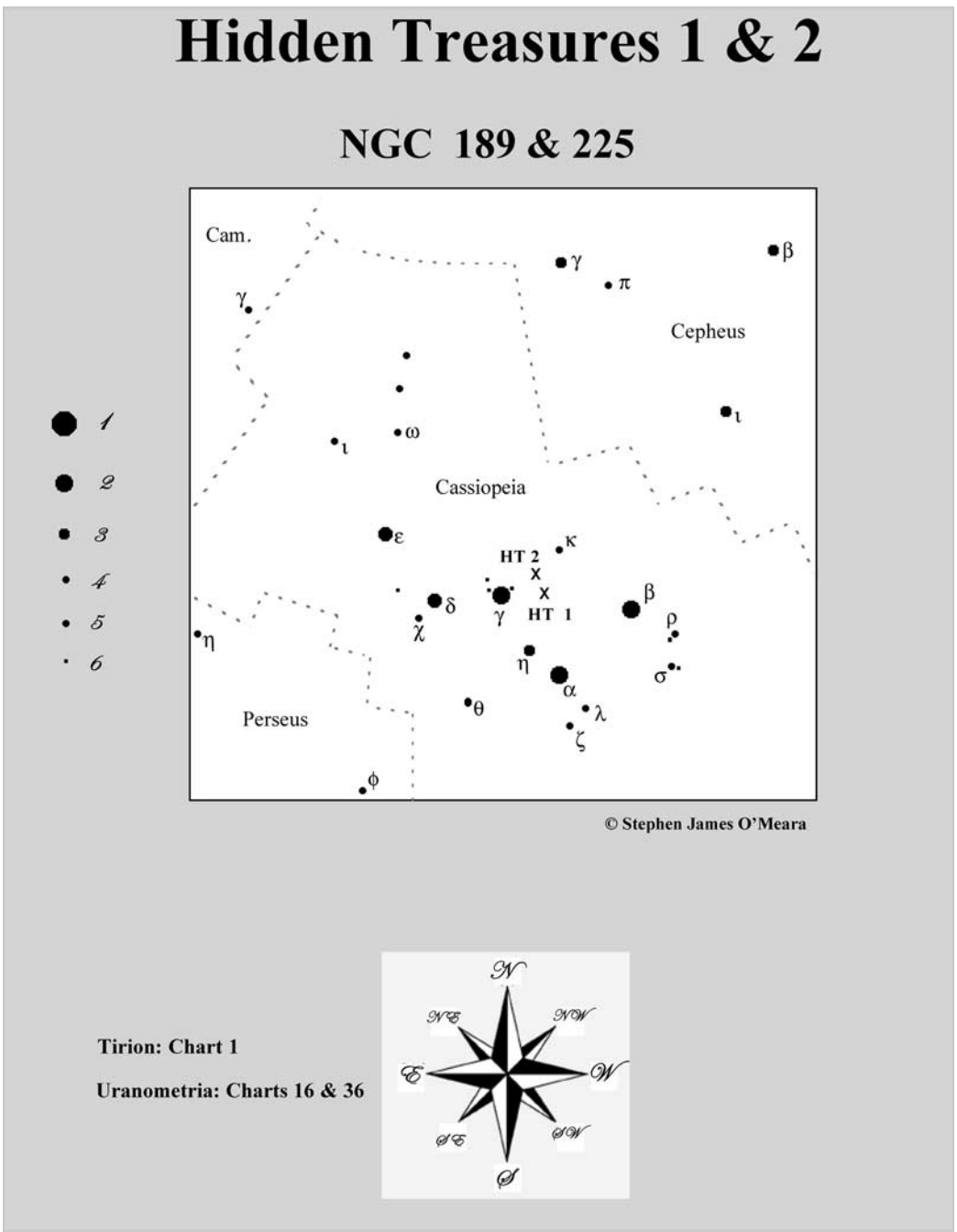
As in *Deep-Sky Companions: The Messier Objects*, the data in this book differ from those appearing in older but popular references. This book contains the most up-to-date astronomical data and accurate historical and observational information about each object in the Caldwell catalog than you'll find in any other book in the popular literature.

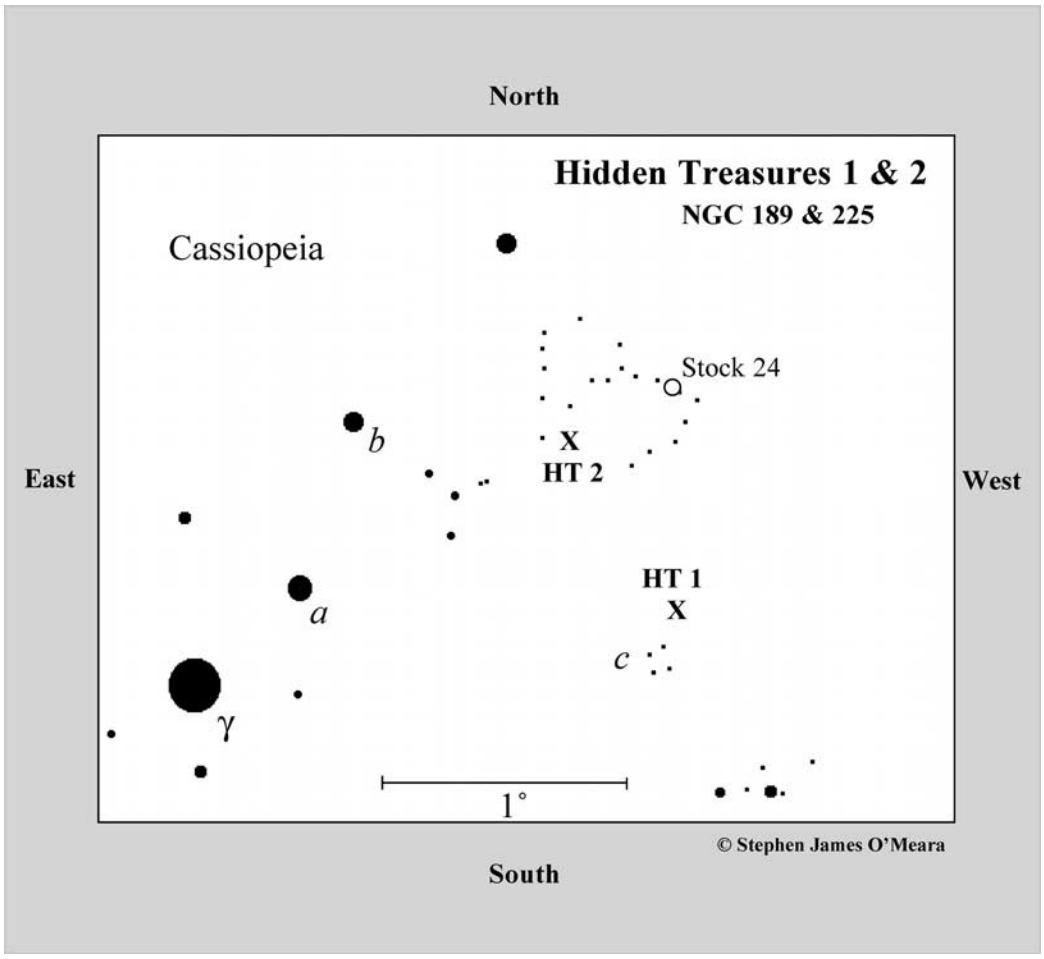
THE FINDER CHARTS

The wide-field and detailed star charts in Chapter 2 are unlike any you've seen. They are of my own design. I created them to look, somewhat, like a treasure map. The hidden treasure number and proper name of each object appears at the top of the chart. An astronomical compass rose can be found at the bottom (north is always up and west to the right). A magnitude scale is at left, and a handy reference to the corresponding star chart(s) in Wil Tirion's *Sky Atlas 2000.0* and the *Uranometria 2000.0* – two of the most popular star atlases used by observers today – are at lower left.

Of course, since this is a "treasure" map, "X" (actually "HT X") marks the location of the object you want to find. Note that often the "X" will not be centered on the map, so you may have to hunt a bit to locate it; it may even be close to the margins of the map. If two hidden treasures are discussed together in the same essay, both objects will

[redacted]





be marked on the same wide-field finder chart with an "X," but they will be differentiated by their hidden treasure number, say, "HT 1" and "HT 2."

The purpose of the wide-field finder charts is simply to show you the brightest constellations or starfields around the hidden treasure. Each show stars roughly to magnitude 6, but generally only in the region around the hidden treasure. Faint stars are more prevalent if the constellation is dim, like Fornax. In creating these charts my philosophy was to get rid of the peripheral noise. Why clutter the view with lots of dim stars and other objects when all you want to do is see where in the sky the hidden treasure lies and which bright stars are nearest to the object?

The brightest stars in each constellation shown have been labeled with either a Bayer (Greek) letter or a Flamsteed number. Some stars may have an italicized lower-case letter, like *a* or *b*; these are additional guide stars, which you'll find in the text as Star *a* or Star *b*, etc. The detailed finder charts have the same orientations and work on the same

principles, only on a smaller scale; a scale bar appears at the bottom of each chart. One symbol, a circle, is used to mark the location of other interesting deep-sky objects nearby, a label with the object's proper name accompanies each circle. Note, however, that in the case of *NGC* objects, only the numbers are shown, not the "NGC" prefix. Note too that in the detailed finder charts the italicized letters may also refer to asterisms described in the text.

To find a hidden treasure, then, all you need to do is first locate the object's position on the wide-field finder chart. Next, take note of the brightest stars nearest to the object and locate them on the detailed finder chart. Finally, find the part of the text that describes how to locate the object and simply follow the directions. Nearly all the deep-sky objects mentioned in the text are plotted on the charts, as are named or numbered stars. Sometimes, though, such companion objects or stars being noted are labeled on the photographs rather than on the star charts, especially when the area of interest is small and crowded, as is the case with NGC 281 (Hidden Treasure 3).

THE PHOTOGRAPHS

As in my *Deep-Sky Companions*: *The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects* all the photographs in this book are reproduced in black and white, with north up and west to the right. The vast majority of deep-sky images in this book are reproduced digitized photographs taken by enormous Schmidt telescopes in both hemispheres. These photos have been made available to astronomers and scientists worldwide by the visionary architects of the Digitized Sky Survey (DSS), which can be perused on the World Wide Web at http://archive. stsci.edu/dss/. (The copyright for the DSS photos of objects used in this book rests with the Anglo-Australian Observatory Board, the United Kingdom Particle Physics and Astronomy Research Council, the California Institute of Technology, and the Associated Universities for Research in Astronomy; they are used here with permission.) Detailed credits appear in Appendix E.

In several cases we have also reproduced images from the Hubble Space Telescope and large telescopes like the Canada–France–Hawaii Telescope atop nearly 14,000-foot-high Mauna Kea volcano on the Big Island of Hawaii. These images were used for the sole purpose of inspiring you to use your imagination. You certainly will not see anything like these images when you look through your telescope, but how else can you fully appreciate what it is you are seeing? So do not be discouraged, be enlightened.

THE DRAWINGS

All the sketches in Chapter 2 are composites of field drawings I made at various magnifications. They are shown approximately with north up and west to the right, unless otherwise noted. Whenever possible, the orientation matches that of the corresponding photograph. Scale bars are included to help you size up each object in your own telescope.

The composites show details visible at low, medium, and high power. For instance, I might have seen a galaxy's faint halo readily at low power but not at high power. On the other hand, a small knot in that galaxy's arm might have been obvious at high power but inconspicuous at low power. Both the halo and the knot will appear in my sketch.