DEEP-SKY COMPANIONS

Hidden Treasures

This new and exciting observing guide spotlights an original selection of 109 deep-sky objects that will appeal to sky-watchers worldwide. Stephen James O'Meara's 'hidden treasures' include a wonderful assortment of galaxies, open clusters, planetary nebula and more, all of which have been carefully chosen based on their popularity and ease of observing. None of these objects are included in either the Messier or the Caldwell catalogs, and all are visible in a 4-inch telescope under dark skies, Stunning photographs and beautiful drawings accompany detailed visual descriptions of the objects, which include their rich histories and astrophysical significance. The author's original finder charts are designed to help observers get to their targets fast and efficiently.

STEPHEN JAMES O'MEARA has spent much of his career on the editorial staff of Sky & Telescope magazine. His many astronomical achievements include being the first person to sight Halley's Comet on its 1985 return, he noticing the dark "spokes" in Saturn's B ring before the Voyager 1 spacecraft imaged them, and determining the rotation period of the distant planet Uranus. He received The Texas Star Party Omega Centauri Award for "advancing astronomy through observation, writing, and promotion, and for his love of the sky," and the International Astronomical Union named asteroid 3637 O'Meara in his honor.

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To Donna,
My jewel of the night. Your beauty is incomparable.

To Daisy Duke such a joy,
My little pot of gold at the end of the rainbow.

And in memory of Milky Way, Miranda-Pyewacket, and Pele.
If time is a treasure, we have been robbed. Our love was priceless.

Who wouldst not leave him in his wandering
To seek for treasure in the jewelled skies . . . ?

Edgar Allan Poe
Sonnet – To Science
(Written in youth)

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Preface

We are all treasure hunters – storybook pirates searching for riches in the endless sea above. Taking the helms of our telescopes, we lay a course among the stars with the sails of our imaginations open. And what wonders await us as we make our way through the charted territories of the Milky Way: rich, open clusters of hot, young stars, some still swaddled in their nascent nebulosities; ancient globular clusters, the senior citizens of our galaxy, whose teeming suns are packed together like gold doubloons in a sea chest; there are galaxies too numerous to mention lurking beyond our forest of stars, living out their lives in various stages of evolution; and then there are the ghosts – the smoky shells of dying stars, whose very nature reminds us of the ultimate fate of our life-giving Sun.

These celestial treasures cannot be plundered. They can only make us feel, as Joseph Conrad writes in his 1902 adventure novel, *Heart of Darkness*, "meditative, and fit for nothing but placid staring." And there are jewels in the night almost too numerous to mention, some of which rarely get viewed by amateur astronomers. That is why novel lists of neglected deep-sky objects are becoming increasingly popular among observers. And that is why I created this book.

Hidden Treasures is the third title in my *Deep-Sky Companions* series – the other two books are *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*. This latest work fills an important void. It introduces skywatchers to a new list of 109 deep-sky objects (all visible in small telescopes) not included in the Messier or Caldwell catalogs; 20 additional objects are also listed in Appendix C.

Some objects in the *Hidden Treasures* list are surprisingly bright – bright enough to make one ponder why they have been overlooked. For instance, neither the Messier nor the Caldwell lists include NGC 2451, a 3rd-magnitude "open star cluster" in Puppis known since the seventeenth century; I place the words "open star cluster" in quotes because recent research has shown that this classic object is not a star cluster but an asterism, a chance grouping of stars (see Hidden Treasure 42). Nor do the Messier and Caldwell lists include the 2nd-magnitude Coma Berenices Cluster, which Ptolemy cataloged as a "nebula" in the sixteenth century. And as early as AD 964, Al Sufi described what we now call Brocchi's "Cluster," the famous Coathanger in Sagitta (yet another "cluster" turned asterism). To understand why these objects were not considered, we need to understand the purpose of the Messier and Caldwell catalogs.

Despite popular belief, the Messier catalog is not a list of the "brightest and best" deep-sky objects for small telescopes. It is a list of objects that Messier believed could be confused with a comet that was "just beginning to shine." Its purpose, then, was to help the astronomers of his day, not the celestial tourists of today. Similarly, despite popular belief, the Caldwell catalog does not "pick up" where the Messier catalog left off. In fact, the intent of the Caldwell catalog – to challenge the celestial tourists of today – is just the opposite of the Messier catalog. What's more, Caldwell list's creator, Sir Patrick Caldwell-Moore, selected the objects not because they were the "brightest" and "best" non-Messier objects in the heavens, but because he thought they were either aesthetically pleasing, visually challenging, or astrophysically interesting. And while the Caldwell catalog does include some of the most celebrated non-Messier objects in the night sky – the Double Cluster in Perseus, the Eta Carinae Nebula, the great globular clusters Omega Centauri and 47 Tucanae, and more – it also includes some very dim ones: IC 1613 (an irregular barred dwarf galaxy), NGC 7635 (the Bubble Nebula), and Sharpless 2–155 (the Cave Nebula); all targets more suited for astrophotographers or visual observers with large-aperture telescopes.

That the Messier and Caldwell catalogs are different is good. Both challenge modern observers in their own ways. But, as I have said, there are more celestial treasures hidden among the stars, within the grasp of small-aperture telescopes. Clearly then, there is room for another list of 109 objects that will inspire us to get out and observe, to move beyond the Messier and Caldwell catalogs, and to enrich our observing experience.

WHAT IS "BEST?"

Some experienced deep-sky observers and several astronomical societies have created lists of what they believe are the "finest" or "best" deep-sky objects in the night sky. Many of these lists include objects in the Messier and Caldwell catalogs, as well as some other very stunning and overwhelmingly popular objects not on these lists. But once you remove these objects, few of these "best-of" lists agree on what is "best" to observe. The fact is if everyone agreed on which objects are the "finest," we wouldn't need more than one list. The choices would be clear. But they are not.

When you look up at the sky, what is your favorite star? Which is the "best" constellation? Will others agree? I have many trees and flowers in my yard. Some are my favorites. My wife, Donna, has her favorites too. But do we agree? What about a professional baseball team? If we exclude all the big-name sluggers and pitchers, who's the "best" of the lot? What's your criteria for choosing? Does everyone use the same criteria? Who's your best friend? How do you make such a choice? Will you ever change your mind? Why?

So you see the problem. Saying that someone or something is the "best" is highly subjective, if not extremely personal. The reason the Messier catalog has been so popular with observers worldwide for centuries is because all of the objects are visible in small telescopes. That's not the case with many of the current "best of" or "finest" lists available today. The irony of the Messier catalog, and we come full circle with this point, is that, despite its wide popular appeal, it is

not a list of the "brightest" and "best" deep-sky objects.

Hidden Treasures is *not* a list of the "brightest," the "finest," or the "best" deep-sky objects. *Hidden Treasures* is a list of 109 deep-sky objects not included in the Messier or Caldwell catalogs. All are visible in a 4-inch telescope. Many are bright. And many have gotten two "thumbs up" from observers around the world. Indeed, many of the objects are not *my* favorites. I selected them because they appear on several "best of" lists, and, when I examined them through my 4-inch telescope, were deemed worthy of inclusion. I went through great strides to make certain that the selection of objects in *Hidden Treasures* consists, in large, of objects that do not require Herculean efforts to be seen in small telescopes.

HOW THE 109 HIDDEN TREASURES WERE SELECTED

Hidden Treasures is original in its creation and scope. The project's roots extend back to 1994, when I began making observations for *Deep-Sky Companions: The Caldwell Objects*; that's also when I began making systematic sweeps of the night sky for comets with my 4-inch f/5 Tele Vue refractor at 23×. As all comet hunters know, the night sky is filled with masqueraders. Whenever I encountered an object not in the Messier or Caldwell lists, I recorded it in a special log set aside for "Additional Objects" – ones that would form the foundation of the 20 additional objects to be spotlighted in *Deep-Sky Companions: The Caldwell Objects*.

The name "hidden treasures" evolved over time. Its origins date to April 30, 1997, when I swept up globular cluster NGC 5286 in Centaurus, and noted that it was "hidden" in the glare of M Centauri. Two months later, I encountered another globular cluster, NGC 6441 in Scorpius, "hidden" in the glare of G Scorpii. Then, on the evening of December 27, 1997, I found the galaxy NGC 404 "hidden" in the glare of Beta Andromedae. Suddenly the idea for a new catalog of objects emerged; that evening I sat down and began drafting a short list of potential "hidden treasures"; what started as an investigation in thought turned into a 10-year treasure hunt in the sky.

I decided to call them hidden treasures for four primary reasons. (1) Some of the objects, like NGC 404 (Hidden Treasure 5) or NGC 2024 (Hidden Treasure 34) are bright enough to be seen in binoculars but can be easily overlooked because they lie so close to a bright star. (2) Other objects are overshadowed by a more popular (Messier or Caldwell) object nearby; the naked-eye open cluster NGC 1647 (Hidden Treasure 27) lies between the Hyades (Caldwell 41) and Messier 1 (the Crab Nebula). (3) Some bright nebulae are small, and they appear on star charts as tiny green boxes (sometimes unnumbered), so they are easily overlooked; NGC 1333 (Hidden Treasure 15) in Perseus is a beautiful reflection nebula that appears on many popular star charts as a box, no bigger than the symbol for a 4th-magnitude star, and NGC 2163 (Hidden Treasure 35), aside from being totally obscure, is a stunning, bipolar planetary nebula in Orion visible in a 2-inch refractor. And (4) some objects – such as the "peculiar planetary" NGC 1360 in Fornax – just seem to lie in regions of sky that are, for one reason or another, neglected by observers due to the lack of bright stars nearby. *Hidden Treasures*, then, will open up a whole new window on the universe for small-telescope users who want to move beyond the Messier and Caldwell catalogs.

When I began my treasure hunt in December 1997, I recorded only objects that were easy to see (meaning visible at a glance), or ones that had immediate *"wow* appeal." The list grew from about two dozen objects in 1998 to about 125 objects by the end of 2001. That's when I became curious as to how popular these objects I was finding were to other observers. I began researching the World Wide Web and other sources for popular deep-sky-observing lists from around the world. The ones I selected for comparison are listed below in alphabetical order:

- "Best Objects in the New General Catalog," A. J. Crayon and Steve Coe, Saguaro Astronomy Club (Phoenix, Arizona).
- "Best Sky Objects: from South African Astronomical Observatory Latitude," John Caldwell, SAAO (South Africa).
- *Celestial Harvest: 300-Plus Showpieces of the Heavens for Telescope Viewing and Contemplation*, Mullaney, James: Mineola, NY: Dover Publications, 2002; formerly *The Finest Deep-Sky Objects*, Mullaney, James and Wallace McCall, Cambridge: Sky Publishing, 1978.
- "Finest N.G.C. Objects," Alan Dyer (Royal Astronomical Society of Canada).
- "Herschel 400," Ancient City Astronomy Club (St. Augustine, Fl).
- "Index Caldwell Catalog," Ian Cooper (Palmerston North, New Zealand).
- "Jack Bennett Catalogue," Jack Bennett (South Africa).
- "Supplementary Catalogue of Bright Deep-Sky Objects," Richard J. Smith (Plymouth).
- TAAS 200, The Albuquerque Astronomical Society (New Mexico).

I suspected that once all the Messier and Caldwell objects were removed from these lists, the overlap would not be overwhelming. I was right. The reasons are many. Some of the lists are for Southern Hemisphere observers, others for Northern Hemisphere observers. The lists also vary depending on the observer's latitude: the list created by the Albuquerque Astronomical Society, for instance, includes more southern objects than does that for the Royal Astronomical Society of Canada. Some of the lists include double and multiple stars, others do not. It also became clear that few of these lists were created solely for the benefit of the small-telescope user.

The challenge I faced was to try and make a compelling list of new deep-sky objects that do not appear in the Messier and Caldwell catalogs, are about 10° above the horizon from latitude 40° north, and can be seen in a 4-inch telescope under a dark sky. To achieve that goal, I went through each list and removed all the Messier and Caldwell objects, followed by the 75 objects I had in my personal hidden treasures list. Next, I removed any objects that could not be seen from my latitude criteria. That left me with 75 objects from my original hidden treasures list and some 80 additional objects from the other lists.

I needed only 129 objects (the 109 hidden treasures plus 20 additional objects), so I further refined the list by including only those objects (with a few exceptions) that appeared in two or more of the selected lists. Since I did not know what their objects looked like through a small telescope (many of the lists used in this comparison were created for observers using larger scopes), I went out and observed all of them with my 4-inch telescope over the course of a year,

and removed from the list any objects I could not see, or found very difficult to see.

In time the concept of the Hidden Treasures list evolved further. After sifting through the Messier and Caldwell lists, I realized that they contain a wealth of deep-sky objects discovered prior to September 1782, when William Herschel began his great deep-sky survey. I wondered how difficult it would be to complete that historical list, to include in *Deep-Sky Companions: Hidden Treasures* all the other deep-sky objects that did not make it into those lists. It turned out that the task could be accomplished with minimal effort, as long as I discounted all double or multiple stars mistaken for nebulae, any questionable or missing objects, and the Large and Small Magellanic Clouds. Therefore, anyone who buys the first three volumes of *Deep-Sky Companions* will have at their fingertips the history and astrophysics of every deep-sky object discovered prior to 1782 – up to and including the discoveries made by Caroline Herschel. Six of these objects, all discovered by Abbé Nicolas Louis de Lacaille, cannot be seen from latitude 40° north, but they are bright southern-sky objects. Therefore, only about 103 objects will be 10° or higher in the sky as seen from a latitude of 40° north; I say, "about," because one object, NGC 1291, a fantastic galaxy in Eridanus, is only 1° south of that cut-off point.

THE FINAL LIST

The final Hidden Treasures list did not end with the addition of the historical objects. In fact, the list changed more than two dozen times in the course of 10 years. Sometimes I would either come across a new object in a comet sweep, other times I would learn of a neglected object in a literature sweep. It was incredibly difficult at times to decide which objects should be included in the main list. For instance, shortly before I finalized my list, I decided to pull two of my favorite galaxies – NGC 134, in Sculptor, and NGC 5907, in Draco – because I thought they might be a tad too faint for some small-telescope users. I replaced them with two unanimously "better" and brighter objects. Actually, creating this book was a great learning experience for me, because, thanks to the "best-of" lists mentioned above, I got to see for the first time so many new and wondrous objects. So the Hidden Treasures list is really, in large part, one created by the collective "you." To illustrate this point, I have, in Appendix D, included a deep-sky list comparison table, so you can see at first hand which individuals, or astronomical societies, thought any particular object was worthy of your time.

The final 109 hidden treasures comprise 38 open star clusters, 35 galaxies, 14 planetary nebulae, eight globular star clusters, eight bright nebulae, one dark nebula, one star of high-proper-motion, and four officially recognized asterisms (two of which were formerly known as clusters and one of which I had independently discovered). In the Messier catalog, M7 is the most southerly object with a declination of 35°. Again, all but six of the entries culminate 10° above the southern horizon from a latitude 40° north. All are visible in a 4-inch telescope under a clear, dark sky. In fact, the vast majority of them can be seen (some with effort) in a nineteenth-century, brass spyglass or 7 × 50 binoculars under the same dark-sky conditions.

The following table compares the number and types of deep-sky objects covered in all three catalogs.

Object comparison table

Object type	Messier catalog	Caldwell catalog	Hidden Treasures catalog
Open star clusters	27	28	38
Galaxies	39	35	35
Globular star clusters	28	18	8
Bright nebulae	7	12	8
Planetary nebulae	4	13	14
Dark nebulae	0	1	1
Supernova remnants	1	2 segments of 1	0
Star clouds	1	0	0
High-proper-motion stars	0	0	1
Double stars	1	0	0
Asterisms	1	0	4

Owners of all three titles in the *Deep-Sky Companions* series will have the most up-to-date astrophysical and visual information on nearly 330 deep-sky objects, with ancillary data on many more. And since the astrophysical, visual, and tabular data in *Hidden Treasures* have been gleaned from many of the same sources in *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*, and since all the objects have been viewed with the same 4-inch telescope under the same sky conditions, observers can compare the physical properties and visual descriptions of any two objects in the three titles with complete confidence. No other series of books to my knowledge offers observers such consistent data.

The Hidden Treasures list includes the brightest, smallest, most unusual, and, arguably, *the* most fascinating planetary nebulae in the night sky. It also includes a double cluster of stars in Perseus, i.e. not *the* Double Cluster, bubbling cauldrons of vapor that mark the sites of intense star formation, starburst galaxies that can manufacture suns at the phenomenal rate of hundreds of millions per year, open clusters so young that the earliest ancestors of humans could have seen them just beginning to shine, and globular clusters so old that they just may be as old as the universe itself. There's a pair of interacting galaxies that are pivotal to Halton Arp's redshift argument (which challenges the almost universally held belief that the large redshifts of quasars and other active galaxies are due to cosmic expansion), and a galaxy whose core may harbor a 10-million-solar-mass black hole. Pink planetaries, yellow globulars, blue clusters, black clouds, they're all here.

As with *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*, the purpose of this book is to offer new and fresh perspectives on the history and visual appearance of each object; to help you find each object; and to summarize the latest research findings on each. In Chapter 1, "About this book," I discuss the telescopes I used to observe the hidden treasures, my observing sites and methods, helpful observing hints, and more. Since the history, astrophysics,

and visual descriptions of many of these objects have never been described at length in any other popular work, this chapter also explains my approach to presenting the information. I detail the 109 hidden treasures in Chapter 2. In many cases the essays describe recent observations from the Hubble Space Telescope, the world's largest ground-based telescopes, and a fleet of spacecraft that now peer (or have peered) into the universe with X-ray and infrared-sensitive "eyes." The essays are also flush with historical anecdotes, including solutions to some outstanding mysteries (including the debate over whether M102 is NGC 5866); observational challenges (naked eye and telescopic); and descriptions of other interesting objects.

Several appendices complete the work. Appendix A is an informative biography of Caroline Herschel written by the esteemed deep-sky observer Barbara Wilson of Houston, Texas. Its intent is not only to complement Larry Mitchell's biography of William Herschel that appears in Appendix C of *Deep-Sky Companions: The Caldwell Objects*, but also to demonstrate how important Caroline's discoveries were to astronomy. The biography is fresh, written from a woman's perspective, and includes several surprises – namely it removes from Caroline Herschel's list of discoveries some objects we have long admired and replaces them with objects that, until recently, no one knew she had discovered. So it is an exciting read. Appendix B tabulates each hidden treasure's position, type, angular size, and apparent magnitude. Appendix C does the same for the 20 additional hidden treasures. Appendix D is a table that lists each hidden treasure and shows which individuals or astronomical societies considered it to be one of the finest in the night sky, or whether it was included for purely historical reasons. At the end of the book, "The treasure chest," is a place for you to "store" each hidden treasure you find. It is, in essence, a checklist. It includes spaces for you to write down important information, such as the date observed, your location, the telescope and magnification used, atmospheric seeing and transparency, and any other special notes you want to record. It is a personal log that you can return to weeks, months, or years later to see how you are progressing as an observer.

Deep-Sky Companions: Hidden Treasures is more, much more, than a valuable resource, or a companion to *Deep-Sky Companions: The Messier Objects* and *Deep-Sky Companions: The Caldwell Objects*; it is *your* companion under the stars. Its aim is to encourage you to observe, to help you find a particular object, and to entertain you, especially on cloudy nights, with the fascinating histories, mysteries, and discoveries that led to our understanding of these objects – our objects. The beauty of the hidden treasures list is that it includes a little something of us all. If there is one thing we amateurs know how to do it is to share – our thoughts, our experiences, and, most of all, our passion for the stars. So go forth into the night and look in wonder at these unsung heroes; they deserve your applause.

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JUST AS NO PIRATE SAILS ALONE, NO author works in complete isolation. I, in fact, had a band of loyal compatriots assisting me in this project. First I'd like to fire a salute to all the observers and amateur astronomy organizations who promote deep-sky lists that go beyond the Messier objects. These lists helped me to steer my telescope toward objects of popular desire. And thank you Al Nagler of Tele Vue Optics for creating such a wonderful "star ship," which has taken me on countless adventures. Special thanks to Ian Cooper, New Zealand's premier deep-sky observer, for educating me on some of the more popular deep-sky objects visible from the southern skies, and James Mullaney for keeping me abreast of the finest northern deep-sky wonders.

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