

Stephen James O'Meara's  
Exploring the Solar System with  
Binoculars

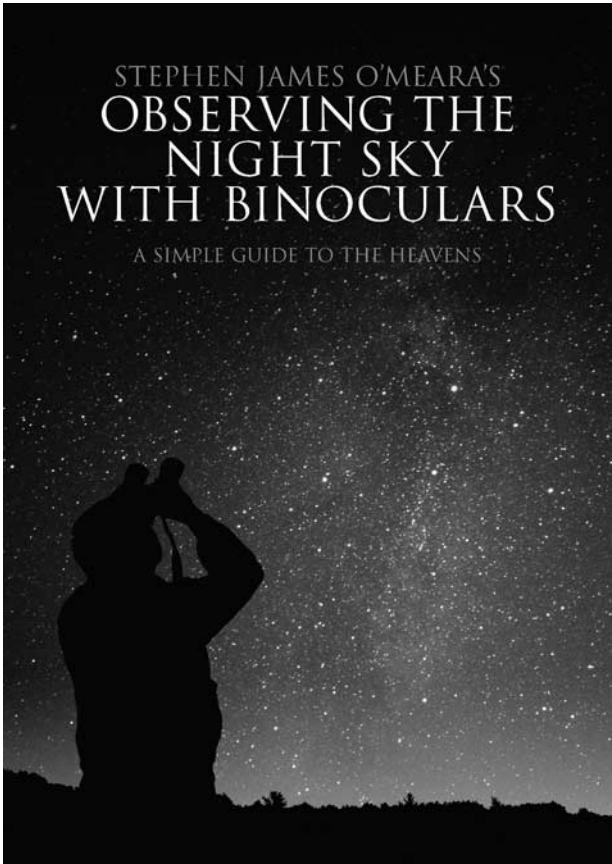
In this journey of discovery, Stephen James O'Meara shows readers how to observe our Solar System wonders with ease and clarity, using the unaided eye, inexpensive handheld binoculars, or large mounted binoculars.

The book presents a new way to see and appreciate the wonders of the Solar System in detail, including lunar and solar eclipses, sunspots, craters on the Moon, planetary detail, meteors, and comets. It is a unique observing guide for all amateur astronomers proving you don't need big and expensive equipment to enjoy astronomy from your own backyard.

Readers will learn how to find Venus in the daytime, how to observe faint features in bright comets, how to maximize your chances of seeing the most meteors during a shower, how to monitor the changing aspects of the planets and their moons, and much more.

STEPHEN JAMES O'MEARA has spent much of his career on the editorial staff of *Sky & Telescope*, and is a columnist and contributing editor for *Astronomy* magazine. He is an award-winning visual observer. His remarkable skills continually reset the standard of quality for other visual observers, and he was the first to sight Halley's Comet on its return in 1985. The International Astronomical Union named asteroid 3637 O'Meara in his honor. Steve is the recipient of the prestigious Lone Stargazer Award (2001) and the Omega Centauri Award (1994) for "his efforts in advancing astronomy through observation, writing, and promotion, and for sharing his love of the sky." He has also been awarded the Caroline Herschel Award for his pre-Voyager visual discovery of the spokes in Saturn's B-ring and for being the first to determine visually the rotation period of Uranus. Steve is also a contract videographer for *National Geographic Digital Motion*, and a contract photographer for *National Geographic Image Collection*.

Also by this author:  
Stephen James O'Meara's  
**Observing the Night Sky with Binoculars**  
A Simple Guide to the Heavens



Month by month, star by star, object by object, Stephen James O'Meara takes readers on a celestial journey to many of the most prominent stars and constellations visible from mid-northern latitudes, exploring the brightest and best stars, nebulae, and clusters visible through inexpensive, handheld binoculars.

“The chapters cover all the major binocular deep-sky objects well, but unlike most such guides, the author devotes even more space to star patterns and individual stars. On the whole, I find this refreshing . . . As always, O'Meara's writing is lively, quirky, and infused with his personality.”  
*Sky and Telescope*

“[O'Meara] relates his invaluable experience as an astronomer, revealing the unique stories and secrets each constellation has to offer, bringing them right down to Earth. O'Meara's writing inspires and his passion and enthusiasm for observing leaps off the pages.”  
*Sky at Night Magazine*

“O'Meara's book really did keep me interested from the outset. . . . The mythology and history of the stars and other objects are explained in engaging narrative, and the reader is left feeling as though they have truly learned about what they have seen . . . ideal for those who want to know more about astronomical objects easily seen with binoculars.”  
*Astronomy Now*

“a fine book that should encourage any possessor of simple optical aids to go out and seek for themselves what the night sky has to offer.”  
*The Observatory*

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Stephen James O'Meara's

Frontmatter

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# Stephen James O'Meara's Exploring the Solar System with Binoculars

A Beginner's Guide to the Sun, Moon,  
and Planets



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To Donna,  
My love orbits around you  
To Milky Way, Miranda Piewacket, and Pele,  
My spirits in the sky  
To Daisy Duke Such a Joy,  
My faithful satellite  
To William (Bill) Albrechet (1917–2009),  
He loved the night

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# Preface

In her 1912 book *The Ways of the Planets* (Harper and Brothers; New York), Martha Evans Martin says that to know the planets is to know ourselves, because the Earth is a planet. This was still true when I was young. Astronomers did not know much about the planets. Venus was thought by some to have humid rainforests capable of sustaining life. Mars still had an air of mystery about it that had some scientists clinging to the hope that its soil contained bacterial life – though more and more astronomers were turning their backs on what they believed was a world as dead as the Moon. And who knew about the distant outer worlds, what mysteries they held?

Today, that picture has changed magnificently. It would be more appropriate now to say that to know our Solar System is to know ourselves. Armadas of spacecraft have explored all the major planets of our Solar System, and we now know their surfaces. We know of towering volcanoes and vast canyons on Mars, erupting volcanoes on Jupiter's moon Io. We've seen new ring systems around other planets and have altered the definition of a planet. We no longer look to the Earth as the only abode of life. And we no longer look to our Solar System as the only system with life. New planetary systems are being discovered around other stars at a rapid pace.

Comets, we now know, are creators and destroyers: They may have given our planet water and seeded it with the building blocks of life. We have also witnessed the frightening effects of comets crashing into Jupiter. Likewise, it's possible that meteorites, blasted from the surface of Mars during its early history, could have transported microbes to the surface of the Earth. They may have also led to the extinction of the dinosaurs; and killer asteroids and comets remain a threat to humanity.

We have also grown accustomed to humans as explorers. Only today, instead of conquering mountaintops, we look out into space for our next great challenge beyond the Moon. The Solar System is our hometown, and we enjoy learning about the wonders of our celestial neighborhood.

The Solar System is more than our home, it is a part of human history. The movements of the planets have played with human emotions and beliefs. Their positions against the starry backdrop have led us into battle, or augured apocalyptic events. Eclipses burned into the eyes and souls of our ancient ancestors who looked upon them with abject fear and wonder. Similarly, great comets have swept across the skies like evangelical swords, and meteors have rained down from the sky like celestial tears.

Of all the things in the universe, Solar System objects were, and still are, the most accessible to anyone beginning in astronomy. All these wonders we can still appreciate today with nothing more than our unaided eyes and a pair of binoculars. And, yes, while we cannot see incredible details, say on Mars or Jupiter, we do have our minds. That is why I've seeded this book with some NASA or other spacecraft images of these worldly wonders, because binocular observing is half reality, half imagination. I want you to appreciate the wonders that you see, not only with your eyes, but also with your mind and heart.

I'll never forget my first views through binoculars, when a friend showed me the four moons of Jupiter. I was a young Galileo seeing new worlds for the first time. These binoculars could also zoom to 20×; so I was shocked also to see the rings of Saturn (or at least the "ellipse" of the rings) – something that I thought was only possible through a telescope. And how could I have imagined that the most distant gas-giant worlds, billions of miles distant, could be seen as small stars in handheld binoculars. Later, I saw the phases of Venus . . . and then, a comet!

From comet tails to meteor trains, from the phases of Venus to the genesis of sunspots, it's all here in this book, which is intended to bring you all that childhood wonder. Its not so much a field guide as it is a companion that will inform you about what's within the limits of your vision – both with your unaided eyes and through binoculars. It is to be used as a companion to my book *Observing the Night Sky with Binoculars* (Cambridge University Press; Cambridge, 2008).

The book is as strongly dedicated to naked-eye observing as it is to binocular observing, and the detail and training I provide in the book will also help you when, or if, you decide to graduate to a telescope. Naked-eye observing goes hand-in-hand with binocular observing. Can you see Venus in the daytime with your unaided eyes? How about Jupiter? Mars? Binoculars, you will find, will be your trusted friend in helping you to confirm the limits of your naked-eye vision.

For the observations made in this book, I used three types of binoculars: handheld Bresser 7 × 50s (Bresser.com; also available at Walmart®), handheld Meade 10 × 50s (Meade.com), and tripod-mounted Orion 25 × 100s (telescope.com). The two numbers on the binoculars refer to the magnification (the first number) and the diameter of each front objective lens in millimeters (the second number). Thus, 7 × 50

binoculars have an aperture of 50 millimeters and will magnify an object (like the Moon or planets) seven times. The greater the magnification, the larger an object appears in your field of view. The larger the aperture, the brighter the object will appear. Binoculars 10 × 50 and smaller can be used comfortably without a tripod. Anything larger requires a tripod. Most astronomy magazines support websites with lots of information helpful to first-time buyers. Two useful articles are Richard Talcott's "Using binoculars" (<http://www.astronomy.com/asy/default.aspx?c=a&id=2225>) and binocular guru Phil Harrington's "Binoculars under \$100," which appears in the April 2005 issue of *Astronomy* magazine. Harrington also has a very helpful website (<http://www.philharrington.net/>). Larger binoculars are especially effective when looking at the Sun through safe solar filters (**never look at the Sun without proper protection; doing so could cause permanent eye damage or blindness**) and the glorious Moon with its myriad detail. Large binoculars also allow you to see faint comets and dim features in their heads and tails; they also reach fainter magnitudes, allowing you to see fainter asteroids and get better views of the colors of the more distant planets. But I have used 10 × 50 binoculars for most of my astronomical career and have found them a trusted friend.

As with any hobby, it takes time to excel. In astronomy, the more you look, the more you will see. So take the time to look and learn. This book is set up in a simple and logical fashion. I begin by looking at the Sun, the nearest star to Earth and the brightest celestial object in the sky. I then help you to explore the wonders of the second brightest object in the sky: the Moon. The Moon is much more than a floating rock; it's the most detailed Solar System body you'll see through binoculars and is reminiscent of the many other moons inhabiting our solar neighborhood. To see the Moon is to see worlds beyond up close and personal. I help you to identify nearly 200 individual features, including its craters, seas, mountains, and more.

In Chapter 3, I investigate the fantastic drama of solar and lunar eclipses. I delve into the histories of these events, and include detailed observations of some little-understood phenomena (there is just so much to see!).

Chapter 4 takes you on an informative tour of the planets, working our way out from the inferior worlds of Mercury and Venus, to blood-red Mars, then on to the tremendous gas-giant worlds (Jupiter, Saturn, Uranus, and Neptune); I also help you to find a bright dwarf planet – a king among the Solar System's minor planets in the Main Asteroid Belt.

Chapter 5 covers the beautiful and exotic comets, reviewing some of the incredible influences they have had on humanity and describing in detail how best to observe them; I also provide descriptions of some of the greatest comets visible to the unaided eyes and binoculars over the last century. The last chapter, introduces you to meteors and meteor showers. I provide ample information on the best showers of the year and how to observe them. I also give details of their histories and the types of displays you can expect from them. Thanks to Gareth Williams, director of the Minor Planets Center at the Harvard-Smithsonian Center for Astrophysics, I've included an appendix of more than 100 bright asteroids to search, especially for those with large binoculars.

Finally, I would like to take a deep bow to Jay Pasachoff (Field Memorial Professor of Astronomy at Williams College) for reviewing the material on the Sun; Fred Espenak (Mr. Eclipse, who recently retired from the Goddard Spaceflight Center) reviewed the chapter on eclipses. Renowned planet observer and author William Sheehan donated his eye to the planets chapter. Dan Green (Director of the Central Bureau for Astronomical Telegrams) lent his excellent assistance on the comets chapter. Meteor expert Peter Jenniskens (Senior Research Scientist at the Carl Sagan Center of the SETI Institute) gave his valuable critique of the meteor section. And Gareth Williams reviewed the section on the minor planets. I would also like to thank Eric Kopit of Orion Telescopes and Scott Roberts of Explore Scientific for their assistance with the binoculars used in this project, my editor Vince Higgs at Cambridge University Press for believing in the book, and Zoë Lewin for her careful eye and sensitive copy-editing. I take full responsibility, however, for any slips of the tongue. Finally, I cannot tell you how thankful I am to my wife, Donna, for her patience during the writing of this work.

Stephen James O'Meara  
Volcano, Hawaii  
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