Foreword

This book was written on the assumption that you, our reader, wish to learn "more than a little" about telescopes, eyepieces, and astrographs. When we undertook this job, we knew it would not be easy. Although we didn't want to dumb down, neither did we want to create an impenetrably technical treatise. Instead, our goal was to impart a deep, solid, and practical understanding of telescope optics.

The result of our several-years-long effort you now hold in your hands. We expect you to learn some optical jargon. And because a modern optical designer's computer does the number crunching, we have concentrated on graphic results from optical ray tracing — rather than numbers — in our discussion. From optical layouts you will learn how the mirrors and lenses in a telescope are arranged; from spot diagrams you can make quick intuitive performance evaluations; and from ray-fan plots you'll learn how to diagnose residual aberrations.

We encourage you to skim the first four introductory chapters — on vision, imaging, and optics — but then skip to the chapter on your favorite type of telescope. Then, perhaps somewhat daunted, you will return to the introductory chapters to learn more of what telescopes are all about. Over the course of weeks or months, as you become familiar with the concepts in this book, you will slowly — but surely — absorb more about telescope optics than you ever thought you could.

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We'd like to deal with a few issues right up front. We recognize that every optical design has proponents and detractors. In some cases, emotions run high. In writing this book, our purpose was to explore and assess telescopes, eyepieces, and astrographs as design equals on a level playing field.

However, we stress repeatedly that most telescope designs have been optimized for a specific purpose. A telescope optimized for visual observing is not likely to be the best astrograph, and we would hardly recommend most astrograph designs for visual use. Our assessments are therefore not one-dimensional and absolute, but rather, are intended to reflect the design trade-offs and observing program for each system that we explore.

Furthermore, we recognize that some designs look good on paper but perform poorly as built, while others look mediocre on paper but do creditably well under the night sky. Where we know this to be the case, we tell you so.

Quite understandably, few firms making telescopes are willing to reveal proprietary optical designs. As a result, this book cannot deal with the actual telescope designs you find in the manufacturer's showroom. However, since optical design is based on physics, there are no real secrets. It has proven fairly straightforward to re-engineer or reverse-engineer most commercial designs. Our assessments *probably* represent the performance of commercial designs quite well. Nevertheless, in our opinion, amateur astronomy would be served well if telescope makers were to publish their designs. We believe that free and open competition would power improvements that would benefit us all.

You don't have to look hard to realize that the telescope industry is fiercely competitive. Many manufacturers consider their designs superior to those of other makers, and do not hesitate to boldly state their claims. Our explorations of optical designs should never be taken to represent the *actual design* of any product, and our performance assessments should not be taken to represent the *actual performance* of any manufacturer's telescope, eyepiece, or astrograph as built and delivered to customers.

We recognize, and we caution our readers to recognize, that many factors beyond optical design can and do affect performance in the built telescope. Designs are theory and exist only on paper. Precision in construction, perfection of optical figure, and quality of components can make or break a design.

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No book that deals with a rapidly changing field like telescope optics can ever be truly complete or entirely up-to-date. New eyepieces and astrographs are introduced every year. During the time we've been working on this book, for example, digital image sensors replaced photographic film in astronomy — completely changing the optical *desiderata* for astrographs.

Assigning credit for ideas in optical design is notoriously tricky. In the course of developing the designs presented in this book, we attribute various optical configurations to their inventors — but as we make clear — supposedly new designs often prove to have been described decades, or even centuries, earlier! In a similar way, telescope manufacturers may be producing excellent designs that we simply did not know. We apologize in advance to any designers and manufacturers whose achievements we have inadvertently overlooked.

And last but not least, the proud tradition of amateur telescope making has largely declined in favor of a burgeoning telescope industry. Although we cover the classical amateur-made instruments such as the Newtonian, classical Cassegrain, and achromatic refractor, many of the designs in this book would prove difficult (but not necessarily impossible) for an amateur to construct. We trust that, should you feel inspired to build one of our designs, you will conduct your own careful studies and assessments before you push glass.

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We conclude by thanking the many persons who have inspired us over the years that we have studied optical design.

Clinton W. Hough mentored Greg during his formative years in high school.

Other teachers, professors, friends, and coworkers encouraged Greg over the years — and special thanks go to Kenneth Moore for writing the optical design program ZEMAX, that made this exploration of telescope designs possible.

Among the people who have instructed and inspired Roger in his optical life, his especial thanks go to Dean Ketelsen, a master optician and good friend, whose heart is as big as all the "acres of glass" that Dean has figured; also to Richard Buchroeder for years of patient and expert advice and instruction; and lastly to Wolfgang Busch and Walter Stephani, two close friends who introduced Roger to the charms and optical richness of Germany, Bergedorf, and Zeiss.

Robert E. Cox imbued in Richard the notion that, in optics, second best is never good enough; telescope optics should be as good as one can possibly make them. Martin van Venrooij and Harrie Rutten gave Richard the opportunity to work closely with the manuscript for their book *Telescope Optics: A Comprehensive Manual for Amateur Astronomers* and the thinking embodied in it — and to Peter Ceravolo go thanks for fresh and lively insights into the design and manufacture of fine optical systems.

We gratefully acknowledge Peter Abrahams, Richard Buchroeder, Eugene W. Cross, Albert Highe, Rodger Gordon, David Groski, Jr., Albert Nagler, Harold Richard Suiter, David Stolzman, and William Zmek for reading various versions of the draft manuscript and freely offering their ideas and suggestions. Also, to John Koester who helped us maintain a reasonably constant writing style throughout the book. Finally, we thank our publisher, Perry Remaklus, who kept this project on track through thick and thin.

Gregory Hallock Smith, Pasadena, CA

Roger Ceragioli, Vancouver, Canada

Richard Berry, Lyons, OR