Preface

Four centuries ago, a hitherto obscure Italian scientist turned a home-made spyglass towards the heavens. The lenses he used were awful by modern standards, inaccurately figured and filled with the scars of their perilous journey from the furnace to the finishing workshop. Yet, despite these imperfections, they allowed him to see what no one had ever seen before – a universe far more complex and dynamic than anyone had dared imagine. But they also proved endlessly useful in the humdrum of human affairs. For the first time ever, you could spy on your neighbor from a distance, or monitor the approach of a war-mongering army, thus deciding the outcome of nations. Stoked by virginal curiosity or just the chance to make money, men of great skill and patience championed the cause to perfect the art of making and shaping ever finer lenses for an increasingly demanding public.

The refracting telescope – that which uses lenses to form an image – is distinguished from all other telescopic designs by its unique pedigree. Seasoned and perfected over several human generations, the refractor has blossomed into a magnificent array of endlessly useful optical tools. Opera glasses, gun sights, spotting scopes, binoculars, and periscopes all derive their power from the basic designs used in instruments perfected for astronomical investigation.

Although the Galilean telescope enjoyed a healthy future with the general public, astronomers who followed Galileo soon began looking for ways to perfect it. First they made the telescopes long. Then, in the early decades of the eighteenth century, a way was found to make them much shorter and thus more convenient to use. This tendency to downsize, which was instituted nearly 300 years ago, shows no signs of abating in the twenty-first century, when small, ultraportable instruments continue to drive the market. Historically speaking, that's the long and the short of it!

The refractor is without doubt the prince of telescopes. Compared with all other telescopic designs, the unobstructed view of the refractor enables it to capture the sharpest, highest contrast images and the widest usable field. No other telescope design can beat it on equal terms. From a practical point of view, refractors are the most comfortable and least troublesome telescope to observe with. They require little maintenance and cool down rapidly to allow you to observe in minutes rather than hours. Because a refractor has more back focus than almost any other form of telescope, it can accept the widest range of accessories, including filters, cameras, and binoviewers.

A generation ago, small astronomical refractors came almost exclusively in the iconic form of a long tube with a doublet lens objective – the so-called achromatic telescope – made from flint and crown glasses, a prescription that had been frozen into place almost 150 years before. These little backyard telescopes, ranging in aperture from 2 inches up to 6 inches, produced images of the heavens so splendid they kept their owners happy for many years. They had to be made with long focal lengths to counteract the principal flaw inherent to the design – false color (or more technically, chromatic aberration). Simply put, the achromatic objective lens acts like a weak prism, spreading the different colors of light out and causing them to reach focus at slightly different points, some nearer and some further away from the eye. This had the effect of degrading the definition of the image, especially when high powers were employed. And although telescopes could be made to reduce false color to an absolute minimum, the length of the telescope had to increase to keep it entirely at bay.

The first glimmer of a breakthrough came at the very end of the nineteenth century, when British optical engineer H. Denis Taylor produced a triplet objective made with new types of glass to reduce this false color by an order of magnitude or more. These photo-visual triplets represented the first truly apochromatic forms, or refractors that exhibit little in the way of false color around bright, high contrast objects. Although the new Taylor photo-visual triplets found their way into many astronomical observatories, their great expense meant that they remained beyond the reach of all but the most well-to-do amateur astronomers, and that's more or less how the situation remained until the 1970s, when a few intrepid optical designers, experimenting with new and improved types of glass, gave way to a new wave of refractor building the likes of which we have not seen in over 300 years. New kinds of artificially grown crystals, fluorite especially, could be fashioned into objective lenses that could eliminate the spurious color thrown up by traditional achromats. Yet these early "Apos," meticulously assembled by such illustrious manufacturers as Zeiss, Astro Physics, and Takahashi, were still prohibitively expensive to most amateur astronomers and thus remained dream ‘scopes for the majority of us.

In the last decade, though, the tide has finally turned in favor of the amateur, with the introduction of a wide variety of high quality Apos available at affordable prices. Ranging in size from ultra-portable (2-inch) 50mm to 8-inch (200mm), there's one to suit everyone's budget. This, together with a wide range of traditional achromatic refractors and spotting ‘scopes being sold across the world, means that there's never been a better time to own a refractor for nature study, astronomy, or photography. And that's what this book is all about – how to choose and use a refracting telescope, both astronomical and terrestrial, to suit your purposes.

After briefly delving into the long historical pedigree of the refracting telescope, we'll continue Part 1 of the book by taking a closer look at all aspects of the design and manufacture of both traditional achromats and their various forms (short-tube, medium-, and long focus), as well as looking at some celebrated classic ‘scopes from the past. In Part !!, there is more of the same thing, only this time round it's with Apos. By first exploring the very nature of apochromatism, we then provide a comprehensive survey of the various genres of Apo refractors currently being sold, including doublets, triplets, and four-element designs, and discuss the meritorious aspects of a selection of popular models used by amateur astronomers. In addition, there is a a chapter in Part II of the book dedicated to sports optics, those small, highly portable models used by nature enthusiasts and astronomers with a passion for travel. An exploration of the relative merits of buying a dedicated spotting ‘scope to the new range of economically priced ultraportable Apos marketed at the amateur astronomy community comes after this. Is an ultra-expensive Leica or Swarovski really in your future?

Maybe you already own one or more refracting telescopes. Then you may find Part III of the book of considerable use. What kinds of accessories might be beneficial to your viewing experience? You'll find some advice in the chapter dedicated to kitting out your refractor. Does your telescope deliver the goods out of the box? We'll be looking at some simple daylight and nighttime tests that can be performed on your telescope to assess its quality. Enjoying your refractor depends a lot on how well mounted it is. Accordingly, there will be a brief survey the types of mounting – alt-azimuth and equatorial – available to skygazers to give you an idea of what best suits you. The well-corrected, unobstructed optics of refractors has made them popular choices for astro-imagers and wild life photographers alike. I'll be sharing some pearls of wisdom that I've learned from some experienced astrophotographers, who routinely use their refractors to create some of the most awe-inspiring celestial portraits ever made.

The refractor has enjoyed an illustrious career spanning the entire history of modern astronomy. But where does its future lie? What's more, now that synthetic ED glass is available cheaply, is it just a matter of time before the humble crown-flint achromat disappears off our radar forever? In the last chapter of the book, we've canvassed the opinions of a number of people who share a passion for the refracting telescope, as well as describing an instrument that helped change the author's own views on the matter irrevocably.

The units discussed in the book are a mixture of the old and the new. Aperture is in units of inches, as this seems to be the way the overwhelming majority of amateurs choose to characterize their instruments. There are also some metric conversions for those few who seem to prefer metric (Do you really prefer 102mm to 4 inches?). In all other matters, standard units are assigned to physical quantities (such as wavelengths of light expressed in nanometers). Technical language has been kept to a very minimum, because it is largely unnecessary to understanding the crux of many of the optical issues discussed in the book. You can always have a look at the glossary and the various appendices if you feel inclined to dig a little deeper.

This book could have been twice as long, so rich and diverse is the history of the refracting telescope. Only a few models within a given genre are discussed. If your telescope has not been mentioned, we apologize unreservedly.

The making of this book was an adventure in discovery, the likes of which I did not expect and I have thoroughly enjoyed the experience. I knew refractors were going to be popular, but I was quite unprepared for the pure, unbridled passion people of all creeds and cultures have for their refracting telescopes. Failing that, if you're just plain curious and would like to know why so many people express such boundless enthusiasm for these instruments, then pull up a seat and enjoy the ride!

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