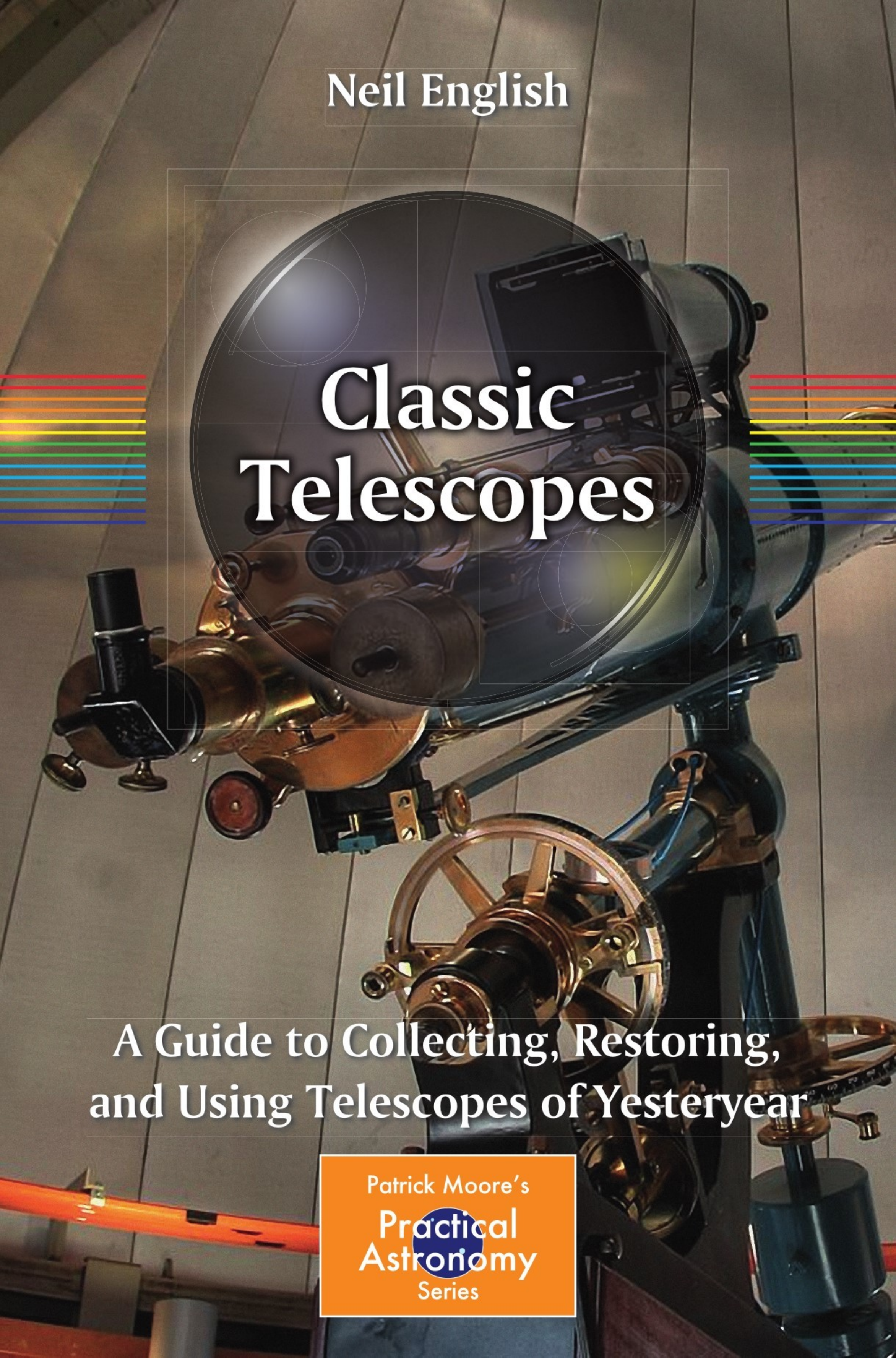
Neil English

Classic Telescopes

A Guide to Collecting, Restoring, and Using Telescopes of Yesteryear



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Springer

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The War is over.
I am at peace.
A New Empire of thought is established, where the lowly are lifted and the humble can take heart.
They shall cower no more, new champions of the heavens emerging on every shore.
'tis a kingdom of memes, auguring an Antonine Age, that illuminates the life of the learned astronomer of yore,
like never before,
whose lonely vigil on hill and mountain high, through freezing winter nights and sweltering summer days, was taken to the grave.

Raise a spyglass to Huygens and Huggins, to Bessel, Burnham and Barnard.
To the Mozart of practical optics, whose death was premature,
to British Cooke and American Clark - the Special Relationship was there for sure.
Three Cheers for Piazzi & Peltier, surveyors of the sky,
and for myopic Dawes, whose noble truths were first received with wry.
The shadows cast by these great men will never fade from view.
They led the way, through brilliant dark, to fertile pastures new.
And when I take my spyglass and turn it to the sky,
I know for sure they saw enough, everything!, to soothe a weary Eye.
The War is over.
I am at peace.

Words dedicated to the memory of my late father, John J. English (1923–2012)

Acknowledgments

Any book as ambitious as this one could never have seen the light of day without the generous contributions of so many people, who have so graciously devoted some of their spare time to share their experiences of their classic ‘scopes. A big thank you to John Nanson, Bob Abraham, Jeff Morgan, Pat Conlon, Dick Parker, Jim Barnett, Richard Day, Gerald Morris, Steve Collingwood, Douglas Daniels, Bob Argyle, Phil Jaworek, Erik Bakker, Bill Nielsen, Alexander Kupco, Juergen Schmoll, Vladimir Sacek, John Leader, Daniel Schechter, Gary Beal, Robert Katz, Colin Shepherd, Es Reid, Richard McKim, William Thornton, Leonard Marek, Clint Whittmann, Martin Mobberley, and Mike Carman.

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Preface
The Appeal of Yesteryear

What has been is what will be,
and what has been done is what will be done;
there is nothing new under the sun.
Is there a thing of which it is said,
'See, this is new'?
It has already been, in the ages before us.

–Ecclesiastes 1:9-10

What a wonderful thing a telescope is! By altering the path of light, using lenses, mirrors, or a combination of both, this awe-inspiring construct of the human mind can let you embark on a journey across hundreds and thousands of light years of space, to witness celestial glories utterly beyond the reach of naked human eyes. How empowering it is to be able to glimpse details of our neighbor, the Moon, or the far distant planets from the comfort of one's own backyard. Telescopes are time machines, behoving us to contemplate the unfathomable natural beauty of the sky.

Telescopes are not mere inanimate objects either. They have personalities all of their own. Uncanny is the person who can't sit behind the eyepiece of a great, old telescope and not be moved by the experience, almost as if one were connecting with some deeply significant moment in the past, when curious minds observed things, perhaps even for the first time.

Over four centuries of time, this revolutionary instrument has evolved into a veritable pantheon of forms that bring the celestial realm down to Earth. They are as much part of our modern civilization as great literature is. After all, they help define humanity's soaring spirit and indefatigable curiosity for the world around us. And while contemporary telescopes continue to deliver the goods, it pays to remember that there really is nothing new under the Sun. Who can inform this author of a single ground breaking discovery, an atmospheric feature on a distant planet perhaps, or maybe a lunar feature, double star or nebulous patch per chance, that was not seen (or could have seen) and noted by our telescopic ancestors? Necromancy and nostalgia, while certainly contributing to the allure of old telescopes, certainly can't explain why they performed so well. The truth, as we shall see, is that many instruments made decades and centuries ago are every bit as good (and in some cases even better) than do many mass-produced telescopes on the market today.

One of the great psychological charms of owning a classic 'scope is that, more often than not, they were hand-built by famous makers or their highly trained technicians. The owner has a direct link to the masters of the past, which, sadly, is not seen too often in the contemporary market with its emphasis on mass production. They are one off, bespoken items, forged from the sweat and blood of optical giants.

As we will discover, many telescopes used by astronomers of generations past were broadly the equal of those employed by our contemporaries. The historical record is clear in this respect, as we shall stumble upon while recounting the extraordinary allegory of the telescope makers from the days of yore. There is much ground to cover and the book, naturally enough, had to be fairly selective in the range of artisans discussed. A classic is best described as a perfectly recognizable form, or archetype if you will, that meets all the specifications of its genre. It usually represents something of lasting worth or with a timeless quality, expressing either its sentimental or objective value at auction. It might also embody the essence of an age or help bring to life fond memories of yesteryear. And while many of these antiquated telescopes command hefty price tags, especially where provenance can be verified, it is simply not true that a classic telescope need necessarily be expensive. One need only note the extraordinary resurgence in interest in the humble 60 mm refractor across the astronomy world to see the truth in this sentiment.

In this book, we shall explore the rich lore of telescopes past, from the small and personal spyglasses of Dollond to the great observatory behemoths designed by Alvan Clark & Sons, USA; Thomas Cooke & Sons, England; and Carl Zeiss of Germany. We will unveil the extraordinary success of Japanese optical firms in the early post–World War II era, where her opticians churned out objective lenses of superlative quality that found their way into cherished brands such as Unitron, Royal Astro, Goto and Swift, to name but a few.

The book will also chart the rise of the reflector telescope from its humble beginnings in Sir Isaac Newton's study at Cambridge, through to the construction of the first parabolic mirrors that enabled celebrated observers such as Sir William and Sir John Herschel to make such enormous leaps forward in our knowledge of the heavens and our place within it. We will recount the development of new technology that did away with heavy and cumbersome metal mirrors and their replacement with silvered glass substrates. Accordingly, we shall take a look at some of history's great mirror makers, including John Calver, John A. Brashear, and more recently, the late Tom Cave, as well as some celebrated Newtonian manufacturers, including Edmund Scientific and Criterion.

The twentieth century also saw great innovations in compact telescope designs, including the Maksutov- and Schmidt-Cassegrain telescopes. This investment in new technologies, particularly the marriage of electronics and optics, led directly to the extraordinary success of companies such as Questar, Celestron, and Meade.

The refracting telescope, in particular, has enjoyed a long and distinguished history among amateur and professional astronomers, with the simple crown and flint objective prescriptions serving their needs for centuries. That said, the secondary spectrum (false color) thrown up by achromatic object glasses impelled opticians to find new glass combinations, with improved color correction. But contrary to what most contemporary amateurs believe, that search had its origins in the eighteenth century, and by the end of the nineteenth century, real progress had been made in the workshops of Zeiss, Germany, and T. Cooke & Sons of York, England.

Interest in designing color free or apochromatic refractors waned a little throughout the first half of the twentieth century but gained momentum again in the 1970s when Japanese opticians, most notably those working for Takahashi, took up the gauntlet once again, bringing to market exciting new high-performance 3-inch refractors. This was followed in the early 1980s by innovators in the United States, including Fred Mrozek and Roland Christen, who designed a new range of oil-spaced triplet apochromats for the discerning amateur astronomer.

As well as describing fully functioning telescopes from memory lane, we shall also explore some restoration projects along the way, including the refurbishment of two of Sir Patrick Moore's most used telescopes – a fine 3-inch F/12 Broadhurst Clarkson, which he purchased as a young lad, as well as a larger 5-inch f/12 Cooke refractor – arguably Moore's most used telescope back in the day.

Finally, the antique telescope market will be discussed with a view to identifying realistic expectations and potential pitfalls of prospective investors. How important is provenance? Will replacing a mirror or lens increase the value of your antique 'scope? These and other questions will be answered as we draw the book to a close. So, in the meantime, pull up a chair and settle down to read about some of the most talked about telescopes in history and something of the personalities that made them.

Yours classically,

Neil English

About the Author

Self-confessed classicist, Dr. Neil English, is the author of two influential books on commercial telescopes, both published by Springer, including the highly lauded *Choosing and Using a Refracting Telescope* and *Choosing and Using a Dobsonian Telescope*. English has conducted extensive research on the properties of the classical refractor and published widely on his findings both online and in commissioned articles for leading amateur astronomy periodicals, including *Astronomy Now*. He lives under the dark skies of rural central Scotland with his wife and two sons.

Chapter 1

The Dollond Century

In the early spring of 2010, this author was contacted by a lady who had the good fortune of inheriting an antique telescope from her late uncle. He was a bachelor and apparently a bit of a misanthrope. The lady had no idea how to set up the telescope or indeed, or what kind of condition the instrument was in. She kindly agreed to lend it to me in order that I might assess its condition. It was a 3-in. F/15 Dollond "The Student's" refractor. It came in a solid mahogany box with several eyepieces (all with solar filters built in). The lens was uncoated but absolutely pristine. It also came complete with a fabulous, full-height mahogany tripod. The tube presented in what appeared to be a green powder coat and a chrome draw tube (Fig. 1.1).

The workmanship on the instrument was quite simply in a different league to anything seen in the modern era. The telescope slotted into a cradle, using two elegantly designed clamps that required no tools. The tripod was about 5′9″ tall when the legs were folded in. The mount head itself was fashioned from some sort of bronze alloy. Locked in place, the Dollond moved with graceful elegance astride its mount, effortlessly moving from one corner of the sky to the other (Fig. 1.2).

The instrument star tested well, with nice, evenly spaced Fresnel rings seen inside and outside focus. It appeared well corrected for astigmatism, coma and spherical aberration. Bright stars like Vega and Capella reduced to hard, round disks at focus, with a faint halo of purplish light encircling them. The Cytherean phase was a delicate crescent, intensely white and sharp, surrounded by the most gorgeous halo of unfocused blue light. The telescope was tested out on a near opposition Mars over a few nights using a 5 mm ocular, presenting up well resolved views of the northern polar cap and some of the more prominent darker markings such as the *Syrtis Major*. The age of the instrument was uncertain, but after conferring with a few knowledgeable antique telescope collectors, a c.1905 date seemed plausible (Fig. 1.3).

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Fig. 1.1 The Dollond arrived in a beautifully made mahogany box (Image by the author)

Fig. 1.2 The alt-azimuth head of the Dollond Student's refractor

The Student's was turned on a number of deep sky objects. The Crab Nebula (M1) in Taurus delivered up its ghostly secrets in a low power eyepiece, and its crustacean morphology was clearly discerned. Higher powers rendered the Ring Nebula (M57) in Lyra as good as any 3-in. refractor ought to; a tiny smoke ring set

Fig. 1.3 Several eyepieces attended the telescope with solar filters attached (Image by the author)

Fig. 1.4 What's in a name? The all-important Dollond logo (Image by the author)

against an anthracite sky. Over in the northwest, the 3° extent of the great spiral in Andromeda (M31) could be traced out with the little Dollond. And high overhead, the glorious Double Cluster (C14) in Perseus resolved to dozens of faint stellar pinpoints (Fig. 1.4).

Fig. 1.5 The uncoated lens was in pristine shape even after a century (Image by the author)

The Student's Telescope performed handsomely on double stars, too. Almach (Gamma Andromedae), Izar and the famous Epsilon 1 and 2 Lyrae were beautifully resolved in this telescope at powers of 100× or so. Indeed, there was little to distinguish it from the images that one can enjoy with more contemporaneous instruments of the same aperture. Needless to say, it was a joy and privilege to have made its acquaintance, to have spied the starry heavens with it. But all good things come to an end, and the instrument had to be returned to its rightful owner (Figs. 1.5 and 1.6).

Yet, this delightful Dollond was but one in a long line of instruments that found their way across land and sea to the far reaches of the British Empire. At auction, it would raise perhaps $2,000 or more. Most of its wealth lies with the name engraved on the optical tube; a name that transcends national boundaries and spans the centuries.

Like many of the optical greats, John Dollond had a famously undistinguished origin. His father was a Huguenot refugee and a silk-weaver to trade, who took up residence in Spitalfields, London. It was here that John Dollond was born on June 21 1706. As a young boy, he was immersed in all aspects of the silk industry, and prospered enough to pursue a classical education, mastering ancient Greek, Latin, geometry, navigational science and astronomy. He was keen to give his son Peter the same background and encouraged him to pursue his own business interests. By the age of 20, Peter had established a small workshop making and repairing optical instruments. It was apparently a great success, as his father wrapped up his silk weaving business within 2 years to join his son.

Fig. 1.6 Ready to go. Set up takes just a few minutes (Image by the author)

The telescopes of the early eighteenth century were almost invariably of the long focus, non-achromatic variety. They were made using a single convex lens with an exceedingly gentle curvature so as to produce a very long focal length that had the effect of reducing some of the many optical flaws inherent to its design. Small, non achromatic refractors could be kept manageably short, of the order of 10–20 ft. As opticians learned to grind still larger lenses, the focal lengths grew almost impossibly long. But that didn't deter the astronomical pioneers of the day. And they came from all walks of life.

Fig. 1.7 A drawing from Hevelius' *Selenographia* displays the cratered surface of the Moon and its libration

One of the first individuals to build really long refractors was the wealthy Danish brewer turned astronomer Johannes Hevelius (1611–87) of Danzig, whose instruments reached 150 ft in length. By 1647 Hevelius published his first work, the *Selenographia*, in which he presented detailed drawings of the Moon's phases and identified up to 250 new lunar features. The *Selenographia* influenced many of the great scientists of the emerging Europe, not least of which were the brothers Constantine and Christian Huygens in Holland (Fig. 1.7).

Disillusioned by the shoddy performance of the toy-like Keplerian and Galilean spyglasses offered for sale by merchants, they set to work grinding and polishing their own lenses for the purposes of extending the work initiated by Hevelius. Between 1655 and 1659, they produced telescopes of 12 ft, 23 ft, and finally an instrument of 123 ft focal length. Instead of using a long wooden tube to house the optics, as Hevelius had done, the brothers Huygens placed the objective lens in a short iron tube and set it high upon a pole. Then, using a system of pulleys and levers, the eyepiece was yanked into perfect alignment with the objective. Christiaan Huygens used a more modest instrument (with a 2.3-in. objective and 23 ft focal length), delivering a power of 50 diameters, to elucidate the true nature of Saturn's ring system, as well as its largest and brightest satellite Titan.

Huygens not only built long refractors, he was an innovator as well. Not satisfied by the standard single convex lens that formed the eyepiece of all refractors of the day, Huygens designed a much better prototype, consisting of two thin convex elements with a front field lens having a focal length some three times that of the eye lens. The result was an eyepiece – the Huygenian – which yielded sharper images and slightly less chromatic aberration over a wider field of view than any eyepiece coming before. Curiously, Huygens also hit on the idea of lightly smoking the glass

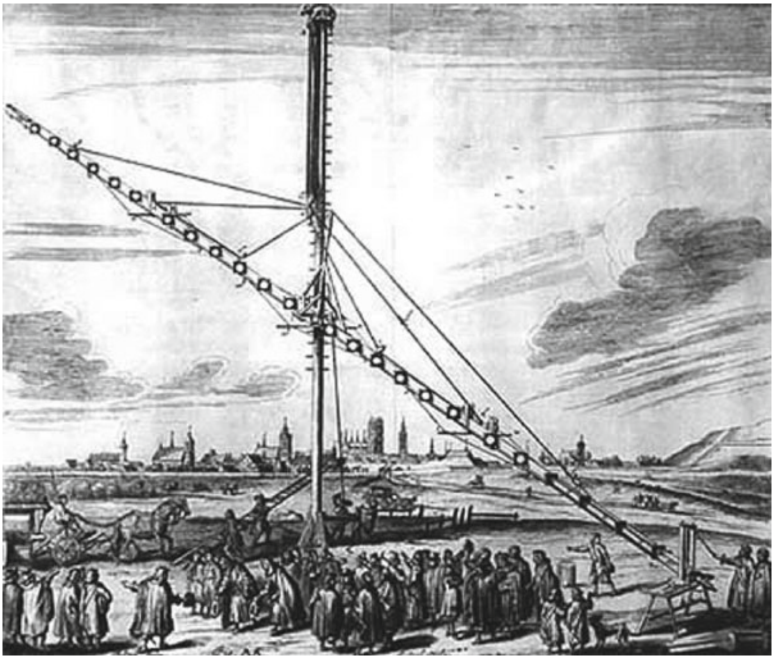

Fig. 1.8 The original 'Hevelius,' one of the largest (150-ft focus) aerial telescopes ever constructed

from which his eyepiece lenses were fashioned, so as to impart to them a yellowish tint. This cunning trick further suppressed chromatic aberration, much in the same way as a light yellow filter does when attached to a modern achromatic refractor. Huygens also appreciated the benefits of proper baffling in designing his telescopes. Placing circular stops along the main tube, these prevented stray light reflected from the sides of the tubes from entering the eyepiece, thereby increasing contrast in the image. Constantine and Christiaan Huygens produced some monster lenses, too. The largest recorded had an aperture of 8.75 in. with a focal length of 210 ft!

But even Huygens' largest telescope dwarfed into insignificance compared to the aerial telescopes made by other determined souls, such as the Frenchman Adrien Auzout (1622–91), who made telescopes with preposterously long focal lengths between 300 and 600 ft (90–180 m). Indeed Auzout also proposed the design of a leviathan telescope some 1,000 ft in length in order that he might observe the animals that inhabit the Moon! (Fig. 1.8)

The great aerial telescopes of the late seventeenth and early eighteenth century, had to be made with extraordinary focal lengths to suppress the aberrations that arise from using a single lensed objective. A biconvex lens cannot focus all the colors of the white light at a single locus. In addition, errors in figuring the lens resulted in the introduction of a suite of other geometrical, or Seidel, errors, including spherical aberration, coma, astigmatism, distortion and field curvature. The only practical way to reduce their impact on the defining power of the image was to increase the radius of curvature of the lens surfaces and that invariably meant increasing the focal length of the singlet lenses.

In his *Opticks*, Isaac Newton tested whether chromatic aberration in telescopes could be corrected by combining two lenses with different indices of refraction. The chromatic aberration of one lens would have to cancel out the other to recreate white light. But according to Newton, this could occur only if the emergent light was parallel to the incident light. Hence, quite famously, Newton abandoned the refracting telescope for the reflecting kind. Newton's erroneous pronouncement that net refraction is always accompanied by dispersion greatly impeded research into achromatic lenses for three decades following.

However, sometime between 1729 and 1733, a London barrister and amateur optician named Chester Moor Hall had serendipitously discovered that one could partially overcome chromatic aberration by combining glasses of opposite powers – a convex lens made from crown glass and a concave element made from flint. It is said that he had studied the problem for several years, firm in his belief (erroneous as it turned out) that the achromatic nature of the human eye would provide the secret design for a new type of lens. Such a doublet was able to correct chromatic aberration for the red and violet rays.

Hall intended to keep his work on the achromatic lenses under lock and key and contracted the manufacture of the crown and flint lenses to two different opticians, Edward Scarlett and James Mann. By a curious twist of fate, they both, in turn, sub-contracted the work to the same person, George Bass, who soon realized the two components glasses were being made for the same client and, after fitting the two parts together, noted the achromatic properties. Bass is rumored to have even sold a number of these instruments to private collectors. Hall failed to appreciate the importance of his invention, and it remained known to only a few opticians for another decade or more.

In 1747, the Swiss mathematician Leonhard Euler (1707–83) took up the problem and published a paper in which he showed that chromatic aberration could be corrected by sandwiching water between two concave lenses. Using the physiology of the eye as his model, Euler used mathematics to prove his conjecture. Bizarrely, he did not seek to establish the result experimentally. In Euler's world view, mathematics could always dispense with experimental science, which was a grave mistake as the events of the following years were to unravel.

When that paper reached John Dollond, then London's leading optician, he was most unimpressed. A staunch defender of Newtonian optics, he denounced it as "destitute of support from either reason or experiment." Indeed, his scorn for the famous mathematician's work went further. Mr. Euler's theorem, he said, "is entirely founded upon a new law of refraction of his own…"

Meanwhile, Euler's paper caught the attention of the Swedish mathematician Samuel Klingenstierna, who reconstructed Newton's experiments in optics and concluded that Newton's results only applied to prisms with small apex angles and that the impossibility of constructing an achromatic lens was fallacious. In 1755