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The Herschel Objects and How to Observe Them

with 90 Illustrations

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To my adult children – three bright stars in my heavens.

Colleen Mullaney Lenfestey
Christine Mullaney Takacs
James William Mullaney

Preface

Many active amateur astronomers today, having already surveyed the clusters, nebulae, and galaxies contained in the popular Messier and Caldwell catalogs, are seeking new horizons to explore with their telescopes. None better can possibly be found than those discoveries made by the great English astronomer Sir William Herschel in the late 1700s to early 1800s. But rather than just over a hundred objects found in each of the former two listings, Herschel's catalog contains some 2,500 entries. This sheer number of targets has discouraged most observers – however avid they may be about deep-sky observing – from attempting to explore these unsung wonders.

In a letter in the April, 1976, issue of *Sky & Telescope* magazine the author suggested a way to make Herschel's list more attractive to observers. His discoveries were arranged into eight Classes, designated I to VIII (see Chapter 3). Of these, 1,893 lie in Classes II and III – his faint and very faint nebulae. Dropping these and taking only those entries in the remaining classes as a working list results in 615 objects – a much more manageable and realistic number of targets to view. This letter was followed by a full-length article on this concept in the January, 1978, issue of *Astronomy* magazine and (much later) another one in *Sky & Telescope* for September, 1992. As a result of these published pieces, observation of the Herschel objects began to grow in popularity among the stargazing community, and acting upon the author's suggestion an actual Herschel Club was started by the Ancient City Astronomy Club in St. Augustine, Florida. This local effort was eventually adopted on a national level by the Astronomical League, a federation of most of the astronomy clubs in the United States. (See Appendix 1 for more about this and other Herschel Clubs, including a short-lived one dating back to 1958.) Unfortunately, the target list adopted by these organizations contains a total of only 400 entries rather than the full 615 that I had recommended (although some of its founding members are now going after the entire Herschel catalog). Among them are many objects of Classes II and III – which are for the most part anything but exciting at the eyepiece – while a number of real Herschel showpieces are overlooked.

The book you are now holding in your hands is the author's answer to a long-standing need for a work devoted exclusively to the Herschel objects and their observation by amateur astronomers, with emphasis on the 615 objects of Classes I, IV, V, VI, VII, and VIII. We begin by examining something of Sir William's remarkable life and times (including a bit about his famous sister Caroline and son Sir John), his many amazing astronomical discoveries, and his home-made metal-mirrored reflectors ranging in size from around 6 inches in aperture all the way up to 48 inches (the famed "40-Foot" – for a time the largest telescope in the world), and take a look at his catalogs and his various Classes. Following a discussion on observing techniques, we shall then profile some 165 selected showpieces from his catalog suitable for viewing with backyard telescopes ranging from 2- to 14-inches

in size (along with a number of fainter objects lying in the same eyepiece fields with them). This constitutes the real heart of this work, and many readers may wish to jump ahead to those chapters immediately. However, knowing something of Herschel's background, the instruments he used to make his discoveries and the nature of each of his classes will add greatly to the ultimate pleasure of viewing those showpieces. We shall also sample some interesting specimens from Classes II and III so observers can get a feel for what these objects look like, and then highlight a number of showpieces that Herschel strangely missed in his "sweeps" of the heavens – plus several of his discoveries that apparently have disappeared from the sky! Various Herschel Clubs will be discussed in Appendix 1, followed by a selected list of Herschel references in Appendix 2 for those desiring to read more about this amazing astronomical family. Finally, rounding out this book in Appendix 3 is a working roster of the entire 615 objects contained in the above-mentioned six classes for those desiring to see all of them as per the author's original suggestion.

And so now dear reader, together let us retrace the glorious pathway in the sky left by this truly great and ardent observer!

James Mullaney
Rehoboth Beach, Delaware, USA
March 2007

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There are many people in both the professional and amateur astronomical community who have helped to make this book possible. Among them are the editors at both *Sky & Telescope* and *Astronomy* magazines, who have kindly published my various articles and letters over the years on observing the Herschel objects and on the formation of a Herschel Club. Dr. Nicholas Wagman, past director of the Allegheny Observatory in Pittsburgh, kindly allowed me extensive use of its superb 13-inch Fitz-Clark refractor (and occasionally its 30-inch Brashear refractor as well!) for conducting visual surveys of deep-sky wonders, including double stars and the Herschel objects. Special thanks go to Ronald Wiltshire and Peter Hingley of the Royal Astronomical Society in London (of which William Herschel was its first president) for kindly sharing its resources with me, including a copy of its 1962 reprinting of the combined *New General Catalogue of Nebulae and Clusters of Stars* (the *NGC*) and both *Index Catalogues*. The *NGC* contains a complete descriptive listing of all of Sir William's deep-sky discoveries (as well as those of his son, Sir John, and many others). Deep thanks also go to both the RAS and Rose Taylor of the Photo Science Library, London, for kindly supplying images of the three Herschel's and their telescopes. I am especially indebted to Dr. Mike Inglis, FRAS, for taking most of the CCD images of selected Herschel objects illustrating this book.* California astroimager Steve Peters has also kindly supplied a number of his personal images of these objects. And my thanks to Charles Feldman, retired IBM engineer, for loading many of the images used in the first few chapters of this book onto CD-ROMs for me. My editors at Springer – Dr. Harry Blom, Christopher Coughlin, and Jenny Wolkowicki in their New York office, Dr. John Watson, FRAS, at their London office, and general series editor Dr. Mike Inglis, himself – have all been most helpful and a sincere pleasure to work with on this, my third volume** for this truly world-class publisher. And finally, I would like to thank my dear wife, Sharon McDonald Mullaney, for her continued encouragement and support during the long process of researching and writing this book.

*Dr. Inglis used 20 cm-, 25 cm-, and 30 cm-aperture Schmidt-Cassegrain telescopes, under a variety of sky conditions ranging from adequate to superb, during 2005–2006. Image reduction utilized MaximIDL, IRAF, and Adobe Photoshop.

**The previous two are *Double and Multiple Stars and How to Observe Them* (Springer, 2005), and *A Buyer's and User's Guide to Astronomical Telescopes and Binoculars* (Springer, 2007).

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Part II **Exploring The Herschel Showpieces**

Part I

William Herschel's Life, Telescopes and Catalogs

Chapter 1

Introduction

Who Was Sir William Herschel?

William Herschel was without question the greatest visual observer who ever lived. Variously regarded as the "Father of Observational Astronomy" and the "Father of Sidereal Astronomy," he single-handedly opened the frontiers of deep space to telescopic exploration. In the course of his grand scheme to study what he called the "construction of the heavens," he discovered literally *thousand*s of previously unknown double and multiple stars, star clusters, nebulae, and galaxies. Talk about "Going where no man has gone before" (to borrow a line from *Star Trek*)! Although self-taught and so technically an amateur astronomer, he transformed the world of professional astronomy – which at the time had been largely concerned with the solar system and the positions of the stars – and set it on a course that is still under full sail today. (Incidentally, the word "amateur" is derived from the Latin word "amare" which means "to love" – or more precisely, from "amator" which means "one who loves." An amateur astronomer is one who loves the stars. And surely no one loved them more than did Sir William.) (Fig. 1.1)

From Musician to Stargazer

Herschel was born into a musical family in Hanover, Germany, in 1739 and moved to England around 1770. Like others in his family, his early career was that of a musician – in his case, teaching and orchestrating music for the city of Bath. It was while there that he became fascinated with astronomy. (Some would say "obsessed" better describes it, for on occasion he would actually run home during performances to observe between acts! And later, as a full-time astronomer, he typically observed from dusk to dawn.) He set about making his own telescopes beginning with small refractors, but soon abandoned them for a variety of reasons and turned his attention instead to reflectors, constructing entire instruments including their speculum-metal mirrors entirely himself. (The familiar silver-on-glass telescope mirror was not introduced until long after Herschel's death in 1822.) But Herschel not only became the greatest telescope-maker of his time, but was also an observer the caliber of which the world had never seen before. He used these homemade instruments to "sweep" the heavens for unexplored celestial treasure, his initial "review" being undertaken with a "7-foot" Newtonian reflector at a magnification of 227×. (At that time telescopes were

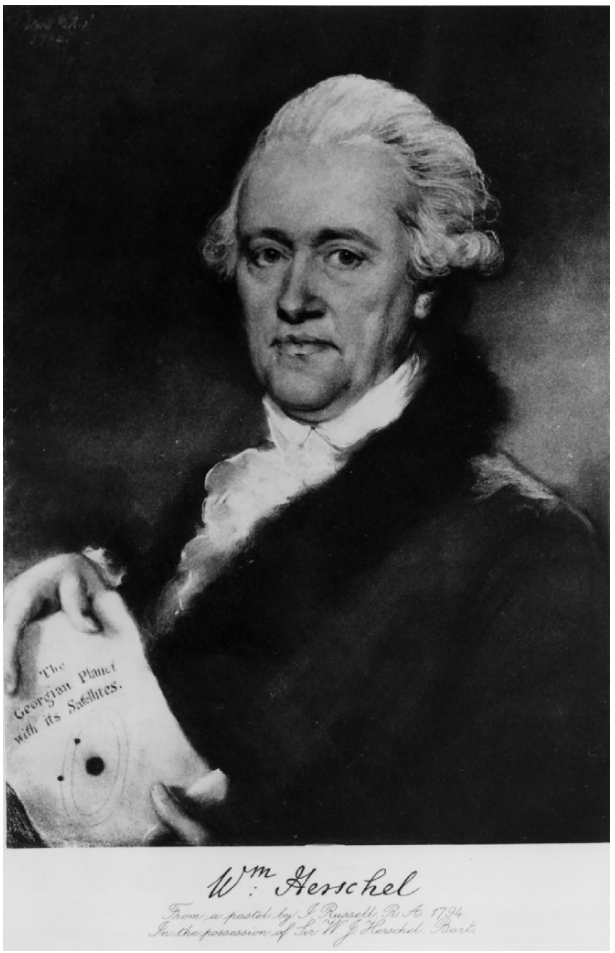

Fig. 1.1. Sir William Herschel at the age of 55, shown holding a drawing of the planet Uranus which he discovered and two of its satellites (which he also discovered). This is a photograph of a famous pastel portrait done by J. Russell, in 1794. Earlier images of Herschel as a young man are very rare and difficult to find. (Fig. 14.1. shows his appearance in his later years.) Yerkes Observatory Photograph, courtesy of Richard Dreiser.

designated by their length rather than by their aperture!) This resulted in his first catalog of double and multiple stars. It also produced one of the greatest discoveries in the history of observational astronomy – made by a totally unknown "amateur!"

Uranus and The King's Astronomer

While sweeping the sky in the constellation of Gemini on the night of March 13, 1781, Herschel came across a small greenish disk of light. Careful observation showed that it was slowly moving among the stars, leading him to believe that it was a strange-looking comet. Others agreed with him and for nearly a year mathematicians attempted to calculate an orbit on that basis. All attempts failed and it

was finally realized that Herschel had, in fact, found another planet! This was the first such world ever *discovered* (the five naked-eye planets Mercury, Venus, Mars, Jupiter, and Saturn having been known since antiquity) and it effectively doubled the size of the solar system. It apparently had never entered anyone's mind that there actually could be more planets lying beyond those already known.

This electrifying and unprecedented discovery catapulted Herschel to instant fame and brought him to the attention of King George III, who appointed him his private astronomer. This honor brought with it a salary sufficient to allow Herschel to give up his musical duties and spend full-time on astronomy. In gratitude, he named the new planet "Georgium Sidus" after his patron, but this did not find approval among other astronomers. "Uranus" was finally chosen instead, in keeping with the naming of the other five planets after gods of ancient mythology.

Caroline and Sir John

No account of the work of William Herschel is complete without mentioning his devoted sister, Caroline. She assisted him both at the telescope at night and in the arduous work of recording and reducing his many discoveries in preparation for their eventual publication. This, in addition to taking care of household duties including meals (even feeding and reading to her brother as he polished his mirrors for hours on end!). She became the leading woman astronomer of her day and the first to find a comet (her record of eight discoveries having stood for nearly two centuries). She observed with a small 27-inch focus Newtonian "comet sweeper" made expressly for her by William, using it to scan the sky on her own when he was away at meetings or showing the stars to the King and his court. Thus, a number of her own deep-sky discoveries are contained in Sir William's catalog – one of the author's personal favorites being the lovely rich open cluster designated HVI-30 (or NGC 7789) in Cassiopeia, to which I have given the name "Caroline's Cluster." (For more on this remarkable woman astronomer, see especially Michael Hoskin's *The Herschel Partnership: As Viewed by Caroline* listed in Appendix 2.) (Figs. 1.2, 1.3)

William Herschel married rather late in life, having a son named John Frederick William, or "John" for short. Like his father and his Aunt Caroline, he too became famous as an astronomer. But he was also a gifted mathematician and scientist in other fields, among other activities experimenting with photography and having taken the oldest existing photograph on a glass plate (a ghostly image of his father's 40-foot telescope!). John is best known for completing his father's survey of the northern sky and (especially) then extending it to the southern sky as well. He spent four years sweeping the heavens from Cape Town, South Africa, having taken his father's favorite telescope – the "Large" 20-foot reflector (see Chapter 2) – and logging thousands of previously unknown double stars, clusters, and nebulae. He returned to England in 1838, a national hero for this work, receiving among many other honors knighthood. Sir John eventually issued a catalog of his findings – and later a combined one containing all of his and his father's many telescopic discoveries. This latter work became the basis for the famed *New General Catalogue of Nebulae and Clusters of Stars* (or *NGC*), which was published in 1888 (Figs. 1.4, 1.5).