

## Chapter 2

### Why Astronomy?

*When I look up at the night sky,  
and I know yes,  
we are part of this universe,  
we are in this universe,  
but perhaps more important than both of these facts,  
is that the universe is in us.  
When I reflect on that fact,  
I feel big.*

—Neil deGrasse Tyson

Astronomy is a science that has fascinated and captivated mankind since the beginning of man's history. Mankind has looked to the heavens and pondered his place in the universe. Astronomy has impacted mankind's art, literature, and beliefs throughout the centuries.

For those who live in a city or brightly lit suburb, the night sky is often hidden by the light pollution caused by streetlights, parking lot lights, neon-lit business signs, and even front porch lights. But a short car ride to the country or to a dimly lit suburb, and the night sky reveals its wonders.

Astronomy is a natural science which studies stars, galaxies, planets, moons, asteroids, comets, and nebulae, and the evolution of celestial objects. Astronomy also includes observing and studying phenomena that originate outside the atmosphere of Earth, including supernovae explosions, gamma ray bursts, and cosmic microwave background radiation. A subset of astronomy is cosmology, which is concerned with studying the universe and its beginnings and evolution. Planetary

science studies the planets, moons, dwarf planets, comets, asteroids, other bodies orbiting the Sun, and exoplanets orbiting distant stars.

People of all ages can participate in amateur astronomy, and gain an understanding and well-being of the universe. This is particularly true for those recently retired individuals seeking a new activity or challenge in their life. Backyard amateur astronomy enables an individual to gain an understanding of objects and phenomena outside of Earth's atmosphere. Astronomy has always been and continues to be that rare activity where an amateur can share contributions with professionals in advancing the scientific knowledge of astronomy.

Many people envision astronomers as nerdy geeks (Okay, some of us are nerdy!) who stare through long white telescopes on isolated hills, but the truth is that there are thousands of amateur astronomers in the world who enjoy the hobby from their backyards. These backyard astronomers come from all walks of life, with both blue-collar workers and white-collar professionals participating. Amateur astronomy welcomes people from all levels of education, from high school level to post-graduate degrees (Fig. 2.1).

Astronomy involves observing and patience. In this often hectic and competitive world, astronomy offers a calmness where the serenity of the night sky can bring a peace of mind. A Zen-like oneness with the universe can permeate one's soul, as an observer can often find themselves in a meditative state under a clear night sky. Astronomy is a most fulfilling and rewarding hobby to pursue. Astronomy as a hobby is something that can be shared with friends, or can be enjoyed solo.

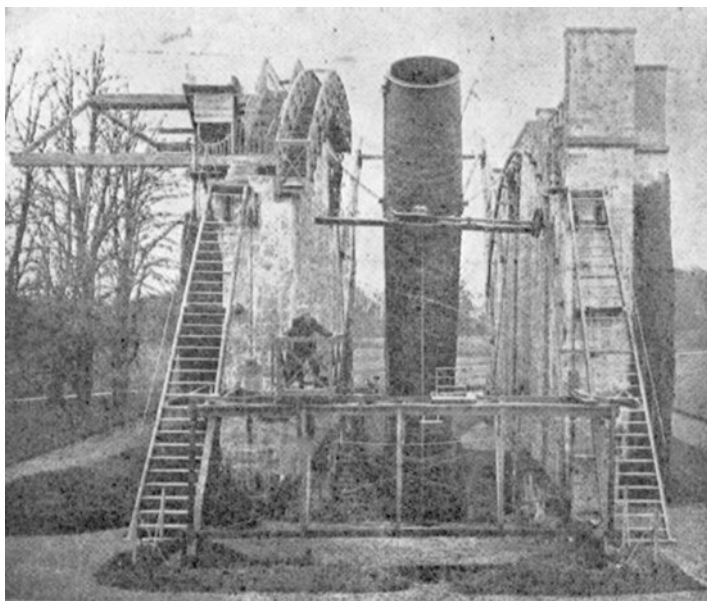


Fig. 2.1 Historic photo of Lord Ross's The Leviathan of Parsonstown (William Parsons)

There is a misconception that astronomy requires sophisticated, expensive equipment. However, many begin in the hobby just performing naked-eye observations, or using a pair of binoculars. Observing meteor showers, identifying constellations, and seeing man-made objects, like the International Space Station as it passes overhead, are activities that require no special equipment for beginners. Many find great satisfaction scanning the night sky with binoculars, finding a treasure trove of star clusters, a few galaxies, planets, and details of the Moon visible through binoculars. As one progresses in the hobby, a telescope becomes a tool for conducting further detailed observations and study, and depending on economics, there are telescopes available for all budgets. Even the simplest, most affordable telescope will reveal celestial wonders to the observer's eye. Of course, for the well-heeled, the sky's the limit (pardon the pun!). For those less fortunate, public observatories and public outreach programs abound in the United States, many supported by astronomy clubs peopled with enthusiastic amateurs willing to show people the beauty and wonders of the night sky. In fact, many astronomy clubs and some public libraries offer loaner telescopes to the public that can be checked, used, and returned like a library book!

### Choosing What Kind of Backyard Astronomer?

Being an amateur backyard astronomer is not just one single pursuit. There are many subcategories associated to being an amateur astronomer (Fig. 2.2).



Fig. 2.2 The author's early photo of the Moon (James Chen)

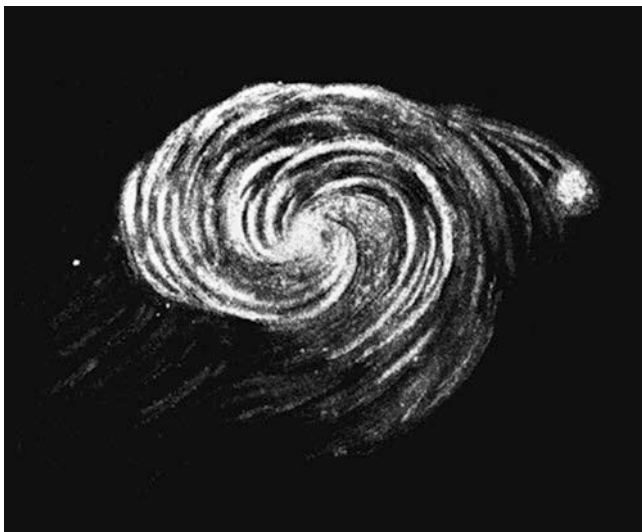


Fig. 2.3 William Parsons, The Third Earl of Rosse drawing of M51 (William Parsons)

**Self-Discovery/Historical Astronomy**—For most people, the first stage of becoming an amateur astronomer is part self-discovery and part appreciation of the celestial beauty. Often, when a new galaxy, nebula, or star cluster is viewed for the first time, all astronomers share the same emotions of discovery and awe that the pioneering astronomers felt. When searching and finding a deep sky object, the observer is following the historical footsteps and observations of Galileo, Sir John Herschel, Charles Messier, Johann Elert Bode, Pierre Mechain, Admiral William Henry Smyth, and numerous other historical astronomy figures. When an object is seen for the first time by an amateur, it is their first time to view it, just as it was for the historical astronomers. It is a thrill that is both personal, yet shared with many astronomers (Fig. 2.3).

**Scientific Astronomy**—There are amateur astronomers that participate in actual scientific studies and contribute to the science. There are devout amateurs who perform occultation timings, where an asteroid passes in front of a star and blocks the star's light. Numerous occultation timings are performed across the country, with the timing data of the occultation being sent to the occultation organization for processing, resulting in a determination of the asteroid's shape and size. There are amateurs that regularly make variable star observations, providing data on variations of brightness of variable stars. This data is then passed on to observatories or universities to compile and analyze. In the past, comet and asteroid hunting was left up to the amateur astronomy community, although that has now being taken over by professional astronomers seeking to avoid worldwide destruction from a comet or asteroid striking the Earth. Initial supernova observations are often reported by amateur astronomers and reported to observatories. Astronomy remains one of the few sciences where an amateur can make a contribution.



Fig. 2.4 An amateur astrophoto of M45 The Pleiades (John Livermore)

There are programs that exist where nonscientific members of the public contribute to data reduction or data analysis to aid observatories. For example, high school students in Northern Virginia and West Virginia regularly analyze radio telescope data from the National Radio Astronomy Observatory at Green Bank, West Virginia, to discover new pulsars. A number of new discoveries have been identified from this program, contributing to the science of astronomy and adding to the higher education of scientifically minded youth (Fig. 2.4).

**Astrophotography**—Countless number of people involved with astronomy want to take pictures of their observations. There is a technological desire of those first entering the hobby to share their observations in the form of images of the stars, galaxies, planets, etc. In this day of point-and-shoot cameras and cellphone cameras, the assumption is that astrophotography is easy. Nothing can be further from the truth. Any previous experience in photography is minimized when attempting to image the celestial sky. Whether using a dedicated CCD astro-camera, a modified DSLR, or doing it the old-fashioned way using a film camera, there is a steep learning curve that must be climbed by the novice backyard astronomer. This activity is not for the faint-of-heart. The backrooms of many telescope stores are filled with telescopes, equatorial mounts, and camera adapters from failed attempts at this part of the astronomy hobby. Be forewarned. Please spend 2 or 3 years in naked-eye observing before entering the minefield known as astrophotography. That way, if astrophotography isn't appealing, the hobby of astronomy will still be there (Fig. 2.5).

**Public Outreach and Space Education**—Amateur astronomers and their astronomy clubs are dedicated to educating the public on the subjects of astronomy, space



Fig. 2.5 An amateur astrophoto of Jupiter (Jon Talbot)

sciences, and space exploration. Star parties are held at locations all over the United States and the world to serve as a common ground for both established observers and those new to astronomy to gather. Astronomy clubs all over the country hold public outreach sessions at local, state, and national parks inviting the public to see the night sky through the club members' telescopes. Educational talks about astronomy are given at public and private schools and libraries. Public education about astronomy is a very rewarding activity for many in the amateur astronomy community.

For this author, public outreach resulted in a teenage high school girl discovering the stars and eventually going to college to study astronomy. She is now working on her doctorate degree in astrophysics. All this because of three weekend nights when she and her parents came to the author's home to observe a comet through the author's collection of telescopes. She was so excited and enthusiastic about the comet and astronomy that she wanted a telescope to explore the night herself. Within weeks, her father and the author built a six-inch Dobsonian telescope in her father's garage. By her senior year in high school, she had become involved in occultation timings. At high school graduation, she was accepted to a prestigious California university to study astronomy. All this began because of three Saturday nights looking through a telescope. The positive impact on a young person's life can be significant and rewarding.

**Gear Head**—There are those in the hobby that are rightly categorized as Gear Heads. Telescopes, eyepieces, and accessories can be found in every room of their house.



As seen from the photos, this author is a part of the lunatic fringe known as gear heads. The author's excuse to his wife is as follows: "I don't drink. I don't smoke. I don't fool around. And you know exactly where I am at midnight, in the backyard with my telescope." (Figs. 2.6, 2.7 and 2.8).



Fig. 2.6 Part of the author's collection of telescopes (James Chen)



Fig. 2.7 More of the author's collection of telescopes (James Chen)



Fig. 2.8 The author's collection of eyepieces (James Chen)

As one gets more involved in astronomy, one discovers that one telescope doesn't do all jobs. Refractors are desirable for observing the Moon and planets. Newtonians (which includes the Dobsonian telescopes) are the best bang-for-the-buck big aperture telescopes. Catadioptrics, including Schmidt-Cassegrain and Maksutov designs, are highly portable. Eyepiece designs offer wide field, high contrast, or high eye relief for those who wear glasses. There are adapters for telescope mounts, and there are electronic drives, computerized mounts, camera adapters, and dew zappers. The list goes on and on. To some extent, every amateur becomes a gear head.

Gear Acquisition Syndrome, or GAS, is a common affliction among amateur astronomers. There are amateurs who collect telescopes with low serial numbers in an attempt to secure serial number 0001, or close to it. Some try to collect every eyepiece of a particular manufactured series or design. Often, an amateur will have a "big eye" telescope for deep sky observing and a "grab-and-go" telescope for situations as the name implies. Many planetary enthusiasts will insist on owning more than one high-resolution and high contrast refractor. In the era of GoTo telescopes, many amateurs are upgrading to computerized telescopes. The telescope manufacturers and telescope store owners are happy and more than willing to fulfill the GAS needs of the amateur astronomy populace.

**Antique Restoration**—There are a great number of aging and historic telescopes in the United States and the world awaiting restoration, and there is a small group of amateur astronomers who are devoting their time and energy in restoring these treasured scientific instruments to proper working order. Old telescopes exist in major observatories. Old telescopes exist in dark corners of garages or basements. There are dedicated and skilled amateurs who are willing to spend time and money





Fig. 2.9 A restored Alvan Clark 5-inch refractor at the U.S. Naval Observatory (USNO photo)

into cleaning and aligning the optics, rebuilding and lubricating mechanical parts, repainting and polishing telescope tubes and focusers, and making operational old telescope mounts. The smaller telescopes, such as an old Mogeys 3-in. or Brashear 4-in. refractor, can be restored by a single individual in his workshop. Larger observatory based instruments are returned to operation with the efforts of a team of skilled technicians. The thrill for these people is the same for those who restore old automobiles or airplanes. The author has restored a Unitron/Polarex mechanical clock driven equatorial mount (Figs. 2.9 and 2.10).

**Amateur Telescope Making**—Many of today's amateur astronomers entered the hobby as amateur telescope makers during the late 1950s or 1960s. This was the Golden Age of Amateur Astronomy and the Golden Age of amateur telescope making. Each month *Sky and Telescope* magazine would feature plans for building a particular telescope. Amateurs were grinding their own mirrors and building telescope mounts out of plumbing supplies. These were the early days of astronomy mail order businesses, where eyepieces, optical rouge, mirror blanks, and focusers could be ordered. A second wave of amateur telescope making occurred during the 1980s spurred by the telescope making concepts of John Dobson (Fig. 2.11).

Even with the availability of excellent commercial telescopes and eyepieces, there is a contingent of telescope makers who love working with their hands to produce their own unique telescope. They take great pride and delight in observing the night skies with an optical instrument of their own design with optics ground and tested by themselves. With their own hands, they can build their own mounting

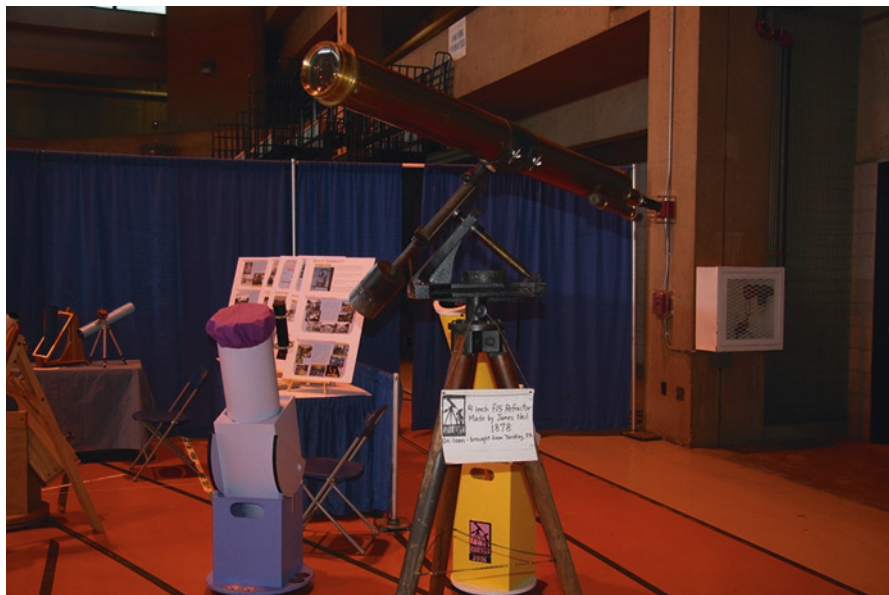


Fig. 2.10 A restored James Neil 4-inch f/15 refractor on display at NEAF 2016 (James Chen)



Fig. 2.11 A homemade DIY telescope (Hands-on-Optics photo archive)



Fig. 2.12 Vincent Van Gogh's *The Starry Night* (Van Gogh)

systems, and align their own optics. There are true craftsmen in the world of amateur astronomy.

**Spiritual and Aesthetic Astronomy**—There is an astronomy subculture who spend their nights gazing through their telescope, pondering their place in the universe, finding solace from the rapid pace of the world, and contemplating the greater glory of the world and heavens that surround them. To these people, backyard astronomy represents an opportunity to meditate and become one with the universe.

Some sky watchers are attracted to astronomy to observe Nature's beauty in the sky with its wide diversity. They appreciate the starkness of the Moon's craters, the ever changing clouds of Jupiter, the wisps of nebulosity of M42, the Great Orion Nebula, and the pinpoint jewels of light in M13, the Great Hercules Cluster.

Here is where the artists reside, peering into the night sky and drawing, painting, or writing of the wonders, the majesty, and the beauty of the universe. The world and the universe as seen through the artist's eye is much different than through an scientific eye. There is plenty of room in life for both viewpoints (Fig. 2.12).

**Online/Remote Astronomy**—Within the past few years, a number of Internet sites have been created to enable astronomers to use remote telescopes to observe. Each telescope is equipped with an imaging camera, and software applications allow the user to control the telescope from the comforts of home using their desktop/laptop, or tablet to observe. Although this is no substitute for actual eyeball-at-the-eyepiece observing, this is an interesting alternative to lugging telescope equipment outdoors and getting either frostbite or mosquito bites. This is a great opportunity for the

handicapped astronomer to participate in the hobby. Examples of such sites are [iTelescope.net](http://iTelescope.net), [telescope.org](http://telescope.org), and [skycenter.arizona.edu/programs/remote](http://skycenter.arizona.edu/programs/remote). Some computer savvy is required.

**Bookshelf Astronomy**—Pity the poor bookshelf astronomer, reading every science book at the library and from bookstores, yet never actually looking through a telescope. Like the related cousin, the bookshelf traveler who never travels, the bookshelf astronomer never experiences the joy, awe, and wonderment that peering through an eyepiece of a telescope can bring.

However, the bookshelf astronomer will gain knowledge of the historical past and the current state of the science that many backyard astronomers would envy. No matter which type of astronomy path that an individual chooses, there should be a little bookshelf astronomer mixed in.

**Meteorite Hunting**—An interesting offshoot of astronomy is that of a meteorite hunter. Part-astronomer, part-geologist, and a good helping of adventurer, this subset of amateur astronomy has a lot of appeal to the outdoorsmen. With the news of a fresh meteor fall or historical data about an old fall, the intrepid hunter will travel to often times remote locales, dig through mud, chop through high grass or trees to hunt down these rocky visitors from outer space. Armed with the knowledge to identify meteorites from ordinary rocks, meteorite hunters will, if successful, collect these space rocks and produce a reasonable income from selling them at star parties, astronomy forums and expos, and to museums if the sample is large enough (Fig. 2.13).

**Solar Astronomy**—Daytime solar astronomy is a fascinating area that many amateur astronomers pursue. Unlike nighttime astronomy, where the emphasis is on the telescope's ability to act as a light bucket, gathering every faint photon of light



Fig. 2.13 Fragments of the Sutter's Mill meteorite fall collected by NASA (NASA)



possible to produce a viewable image, the Sun is eye damagingly bright and the task becomes limiting the brightness of the Sun to prevent damage to one's eyes.

**CAUTION: DO NOT OBSERVE THE SUN WITHOUT PROPER SOLAR FILTERING EQUIPMENT. PLEASE READ THE FOLLOWING:**

1. **Never look directly at the Sun with the naked eye or with a telescope, unless the proper solar filter is being used.** Permanent and irreversible eye damage will result without proper protection.
2. **Never use the telescope to project an image of the Sun onto any surface.** Internal heat buildup can damage the telescope and any accessories attached to it.
3. **Never use an eyepiece solar filter on a telescope.** Internal heat buildup inside the telescope can cause these devices to crack or break, allowing unfiltered sunlight to pass through to the eye and cause irreparable damage and blindness.
4. **Never leave the telescope unattended when viewing the Sun.** People and children unfamiliar with the dangers of viewing the unfiltered Sun may do something stupid if left alone with the telescope. Never underestimate the dumbness and stupidity of the general public.

Observing the Sun is a very dynamic activity. Unlike deep sky objects, such as galaxies and nebulae that never change from night-to-night, week-to-week, or year-to-year, the Sun changes from minute-to-minute. Sunspots move across the face of the Sun. With a Hydrogen-Alpha filter or telescope, an observer can watch as solar prominences develop, grow and expand, and fade. The Sun is easily located, and the observer doesn't lose sleep at night. Solar observing does demand a different suite of equipment, including white-light solar filters, H-alpha filters, and dedicated H-alpha telescopes. Unfortunately, solar filtering equipment is solely dedicated for daytime Sun observations, with no applications for nighttime activity (Figs. 2.14 and 2.15).



Fig. 2.14 A Coronado PST Hydrogen-Alpha telescope (Hands-on-Optics archive)

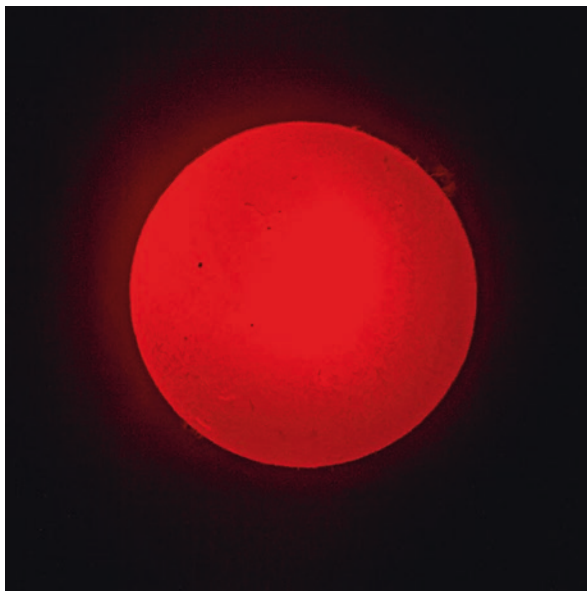


Fig. 2.15 Typical view through a Hydrogen-Alpha telescope (Hands-on-Optics archive)



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