WHAT'S UP?

In the past two weeks, while out and about in Plympton I had the opportunity to talk with a some Plymptonians that enjoy our night skies but that use different types of equipment. One uses binoculars and the other a telescope. So, I thought it was time to talk a little about the equipment we can use in our explorations. First of all, as I'm sure you've gathered by now, no equipment is necessary. Standing out under the night sky and recognizing the patterns and the regular motions of the stars and planets requires nothing more than your eyes and curiosity about what's up there. This is how humans have explored the sky for 99.9% of the past 300,000 years and that was sufficient for people to have figured out what rises when, which groups of stars the Sun seems to move past, that there were five objects that moved differently from the stars (Mercury, Venus, Mars, Jupiter, and Saturn), and even the shape and speed of the orbits of those five planets. I think that's pretty impressive.

Since the 1600's when we started using optical device to enhance our view of the cosmos, binoculars and telescopes of all sizes and designs have increased our enjoyment of what we observe. No one type of design is better than another, they each have their plusses and minuses and each allows use to do things the others don't. Let's start with binoculars. Binoculars, while providing magnified views of distant objects, in general, provide lower magnification than telescopes do. But that's not a negative thing! Binoculars provide a view of a much larger area of the sky than a telescope does and many astronomical objects cover a large portion of the sky. In the last article I mentioned a cluster of stars called the *Pleiades*. This group of stars is best seen in its entirety with a pair of binoculars. Unless you use very expensive telescope eyepieces you just can't see all of the stars in the cluster all at once. The view through binoculars captures the Seven Sisters in one scene and it's beautiful. Slowly sweeping your binoculars along the *Milky Way* as it arches overhead on a summer night, is a contemplative exercise that is unrivaled. Binoculars are lightweight and portable – that's a great combination.

Telescopes provide us with close-up looks. The first things people ask me about a telescope are, "How big is it?" and "How far can you see?" The first question refers to the diameter of the big lens or mirror in the telescope. It's called the *objective*. Think about what's going on when we see something. Light from a distant object moves through space until it gets blocked by something. When it is us doing the blocking, some of the light passes through our pupil (the opening in our eye) and is stopped by the retina (the back surface of our eye that converts the light to an electrical signal that goes to our brain). Now at night, the average diameter of a pupil is about 5 millimeters and the area is about 20 square millimeters. If the amount of light that fills 20 square millimeters is enough to generate a signal to our brain that says, "Hey – there is something there.", then we say we can see that something. Most objects in space are so far away that there's not enough light coming through our pupils for our brains to be able to register that we see it. Now let's say that we look through a telescope with an objective that is 200 millimeters in diameter (about 8 inches). If our pupil was the size of this black dot ●, the 200-mm objective would be the size of the light grey circle on this page. The area of that objective is about 1,600 times the area of the eye's pupil. That means that the telescope is gathering 1,600 times as much light. When that light is focused to a spot small enough to pass through our pupil, it's enough to generate that signal to our brain that says, "Hey – there is something there.", and we say, "Oooo! That's awesome!" That's the story on what the answer to why, "How big is it?" matters. As to "How far can you see?", well the answer to that is that it depends on how *intrinsically bright* a particular far away object is. Think about light bulbs. If you turn on a 30-Watt bulb and a 100-Watt bulb and they are both right in front of you, the 100-Watt bulb is much brighter. If the 30-Watt bulb is right in front of you but the 100-Watt bulb is far away, the 30-Watt bulb will seem brighter. We say that the 100-Watt bulk is intrinsically brighter (it emits a lot more light), but the 30-Watt bulb is *apparently brighter* (we perceive it as being brighter). There are objects in the sky that are 7,000 light years away that we can't see with that 200-millimeter telescope because they are not intrinsically bright, but we can see the Andromeda Galaxy, 2 *million* lightyears away, without even needing a telescope because it is so intrinsically bright (it shines with the combined light of hundreds of billions of stars!).

One last point about using telescopes. Even with all that extra light we can gather and view, what we see when we look though a telescope will NOT look like the pictures we see on the web and in the news. Why? It's because even with all the extra light, galaxies and nebulae (clouds of gas) are still very dim due to their enormous distance from us. Our eyes have two types of cells that convert light to the signals that go to our brains. One type (called a cone cell) is subdivided into three sets of cells that are sensitive to either red, green, or blue light. The signals from these combine in our brains to give us color vision. However, these types of cells need to absorb a lot of light all at once in order to generate a signal. The other type (called rod cells) can't distinguish one color of light from another, but can generate a signal with only a little bit of light. It's these cells that are able to pick up the faint light that comes through our telescopes. The faint objects we view just look whitish grey. The brighter ones might look a bit greenish. We can't distinguish the reds and blues that the electronic cameras can. It is pictures from electronic cameras that create the pictures we see in the media. So, don't be disappointed when you look at the Orion Nebula (M42) and only see a greenish wisp instead of vivid reds. While I enjoy the magazine photos, I prefer the view through a telescope because I know that the image my brain is contemplating was created by the *actual light* that was emitted by the glowing gases and stars of M42 1300 years ago!

Did anyone follow the landing of the *Perseverance* rover last week? According to NASA, the rover will "search for signs of ancient microbial life … to explore the past habitability of Mars. The rover has a drill to collect core samples of Martian rock and soil, then store them in sealed tubes for pickup by a future mission that would ferry them back to Earth for detailed analysis…Strapped to the rover's belly … the Mars helicopter, *Ingenuity*, [will be a test of] powered flight on the Red Planet." We'll be hearing more from Perseverance over the coming years. You can find out more on Perseverance's mission page, https://mars.nasa.gov/mars2020/. There is a neat 3-D, 360° viewer of the lander at https://mars.nasa.gov/mars2020/spacecraft/rover/.

You can reach me at astroblog@comcast.net with any questions and comments you have. This is What's Up? Installment #40.
Until next time, Keep looking up! *Barry*