Introduction to Basic Stargazing Part I
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These little articles are not meant to be a complete guide to stargazing – that requires a full-length book. These are just meant to give you a head start, familiarize yourself with some of concepts and terminology, a chance to test the flavor of the hobby sort to speak.

One of the great things about stargazing is how little equipment you need – a pair of eyes and a lawn chair. The more serious stargazer may wish to acquire a pair of binoculars; almost any pair will do, 7x50 perhaps being the most common. **One thing you don't need right away is a telescope.** If the urge to buy one comes over you, resist it with all your might! A proper telescope is a major investment of your time and money and one cannot be found in department stores. A cheap department store telescope might show views of the Moon and perhaps the rings of Saturn but very little else; you will be better off sinking the money you were going to spend on the telescope into a pair of binoculars. That being said, don't run out and buy a pair of binoculars either, borrow a pair from a friend. Optical choices abound and you don't want to make any expensive mistakes you will regret later.

There are two things you probably will want to get sooner rather than later – a star chart, specifically a kind called a planisphere, and a **red** LED flashlight. If you want to save a few bucks, you can print a chart from a link in our website and use a regular flashlight with red cellophane or even covered with red paint. The red color helps protect your eyes' dark adaptation. This is the primary reason I don't recommend those neat little smartphone apps – I have never seen one whose light wasn't too bright. Most constellation are on the dim side and you will not be able to see them after looking at the screen.

If you buy a planisphere, the most important thing you should look for is the latitude its drawn for. Your latitude determines which stars you will be able to see and where to look for them. A chart drawn for Florida's latitude will work reasonably well in Egypt or Hawaii but will largely be a failure in Ontario. The difference being that Egypt is about the same latitude as Florida, but Ontario is not. Also, note that charts meant for outdoor use are printed with white sky and dark stars for ease of reading at night and may be made of plastic to resist the inevitable dew.

The planisphere consists of a disk containing star positions embedded in another disk with time and date marks on it. To use the planisphere, rotate the disk until the current date lines up with the current time. Subtract one hour from the time if you are using daylight savings time. The rivet in the disk center represents the north star and indicates true north. Face north and your planisphere is ready for use! If you are disoriented use a compass to determine north; after tonight you will never again need a compass to find north after dark.

Identify the North Star (also called Polaris or the Pole Star). It will lie the same number of degrees above the horizon as your latitude. A fist held at arm's length covers about 10 degrees, a finger about 2 degrees. Almost everyone knows the Big Dipper or Cassiopeia which can help your orientation, and of course they are clearly marked on your planisphere. Contrary to popular opinion, the North Star is not one of the brightest stars in the sky and may be invisible inside of a city. Polaris is an excellent place to begin your study of the sky.

This brings up an important point. Wherever spot you choose to star gaze needs to be *dark*, as dark a place as you can find. Not just on the ground like inside the shadow of a building, but the sky needs to be dark too. So dark, that a passing cloud looks like a black hole in the sky. Those places are hard to find nowadays, and certainly can't be found near a city, but do the best that you can. Most astronomy clubs know of a spot that is as dark as regional conditions allow where they hold their star parties; join one. It's good to have company in a lonely dark place!

Several millennia ago, as TV and smart phones hadn't been invented yet, our ancestors entertained themselves by staring at the sky. They assigned various patterns of stars names, now called constellations. Turns out that was arguably a stepping stone to civilization, because the study of stars is the beginning of a journey towards a calendar and the constellations were the road map. With a calendar, you can have reliable agriculture, which is the basis of civilization.

Take your star chart and look for the constellation Hercules, just for an example. You will note that the constellation Hercules as drawn does not look much like a man; constellations only occasionally look like the objects they are supposed to represent. The lines are drawn only to serve as a mnemonic to help one find their way around in the sky. Lines date from the early 19th century when they replaced the elegantly drawn images dating from antiquity. There is in fact no official way to draw the lines; artists are free to make up their own variations (and do). Nowadays constellations are defined as a particular patch of sky, not by the stars making them up. The more expensive charts meant for advanced amateurs and professionals omit the constellation lines and just show the boundaries between patches.

A common mistake a beginner makes the first time a planisphere is used is not realizing that constellations are *big*; they all take up a sizable chunk of sky. The little tiny pattern on the chart is in reality a very large pattern in the sky. Eighty-eight constellations cover the heavens from pole to pole of which around half are hidden from view at any given moment.

On star charts you can often see a couple of solid lines, one is the ecliptic, the path the Sun follows across the sky each year. (For those of you who want to be technical it's the Earth's orbit projected on the celestial sphere.) All the major planets and the Moon can always be found within a few degrees of this line. The ecliptic runs through thirteen constellations (not twelve!) with familiar names like Aries, Pisces and Aquarius. As you might have guessed by now this band of sky centered on the ecliptic is traditionally called the Zodiac. Professionals rarely use the word however as it has unwanted connections to Astrology. If you find a bright star near the ecliptic and it's not on your chart – you just found a planet! (There is an extremely remote chance you found a nova instead, but that is an article for another day.)

The other line on the sky chart is the celestial equator, a projection of the Earth's equator on the sky. The two spots where the lines cross correspond to the Vernal and Autumnal equinoxes. When the Sun arrives at this intersection March 20 or 21st it's called the Vernal Equinox - the start of Spring in the northern hemisphere. It's also the zero point of the astronomical coordinate system.
The zero-hour line of Right Ascension (equivalent of longitude on Earth) runs from the North Celestial Pole next to Polaris, through this point, and onwards to the South Celestial Pole. As a beginner you don't need to know anything about Right Ascension except to know that it exists.

To the eternal annoyance of astronomers the Vernal Equinox slowly moves. *Very* slowly to be sure, but astronomers must redraw their charts to match the moving coordinates every 50 years. A couple of millennia ago the point was in Aries, now it's currently in Pisces, and about 6 centuries from now it will be in Aquarius. (The Age of Aquarius!)

It's probably about time we talked about stellar naming conventions. About 250 stars have proper names; most of them are extremely obscure and are virtually never used except in science fiction. Only about two dozen are in common use. The names are mostly of Arabic origin like Betelgeuse, some Greek names like Sirius, together with a handful of Latin derived names like Bellatrix. Constellation names are all Latin. It's important to realize, except for the brightest two dozen or so, Astronomers never use or maybe even learn the names. If you spoke about Bellatrix for example, a blank look might be the only response. Instead Astronomers use catalog designations. There are many catalogs in use; the one most commonly encountered for the brighter stars is the 400 hundred-year-old Bayer catalog. In this catalog stars are referred to by Greek alphabet letters together with the constellation name in Latin genitive case. Bellatrix would be properly referred to in scientific works as "Gamma Orionis". Note the "is" ending on Orion. As it is from Latin it takes the genitive case – one of the annoying traditional things you will get used to eventually. In English, you would probably say "Gamma of Orion", but no one ever does. Newer catalogs read like serial numbers; in one common catalog Bellatrix is "HIP 25336".

Several companies will tell you that for a fee they will assign a star a name of your choice. This is misleading at best and fraudulent at worst. No private company can assign an official name to an astronomical body. By international treaty only the International Astronomical Union has the right to assign names to astronomical bodies. The IAU rarely assigns names to stars and has no plans to do so on a regular basis, although they have been engaged in cleaning up the lists recently. They don't even maintain an official pronunciation guide for the traditional star names we do have. Just how does one pronounce Zubeneschamali anyway? (Maybe calling it "Beta Librae" isn't such a bad idea.)

By some coincidence the brightest stars in the sky tend to appear during the winter. But how bright is bright? Or to put it another way, it's obvious some stars are brighter than others; can we assign a value to the brightness so we can make comparisons between stars that might not be visible at the same time? The first person to do so was Hipparchus more than two millennia ago. He took the brightest twenty or so and said "these stars are of the first magnitude" the next hundred were "of the second magnitude" and so on. The faintest star visible in a dark sky at the zenith to a person of normal eyesight "is of the sixth magnitude."

This worked well enough for many centuries; but when the telescope was invented millions of more stars were visible that were not covered by this scheme; this signaled that changes were required to the system. Then too, a star like Sirius was vastly brighter than the dimmest of Hipparchus' first magnitude stars, Castor. This was a little uncomfortable also. With modern instruments it was determined the average first magnitude star was 2.5 times brighter than the average second magnitude star; and the average sixth magnitude star was one hundred times fainter than an average first magnitude star. As a mathematical convenience then, the five magnitude difference between +1.0 and +6.0 was defined to be exactly 100 and thus the difference between each magnitude was 2.512 (the fifth root of 100). A casual star gazer *does* need to have a feel for magnitude, but does *not* need to know the mathematical basis for it. I just thought I'd throw it out there.

For many years the summer star Vega was the reference star and was assigned a magnitude of 0.0 as a starting point. Now that everything has been reduced to mathematical ratios one can now say Pollux has a magnitude of +1.15 while the dimmer Castor has been assigned a magnitude of +1.9 There is no mathematical reason to stop with positive numbers; Sirius has a magnitude of -1.45 and is thus 22 times brighter than Castor. It is very important to remember that the larger the magnitude the dimmer the star, and the smaller numbers (including the negative numbers) are the brightest. It's an odd system, but we are stuck with it.

There is no reason to limit ourselves to stars when measuring magnitude. Venus often has a magnitude of -4, Saturn might have a magnitude of +0.84 and the asteroid Juno has a magnitude of +9.06 - which you now understand means its almost 16 times dimmer than the dimmest star than can be seen by the unaided eye. A pair of 7x50 binoculars could spot it though - 7x50's enable you to see down to +9.5 magnitude objects or even +10.3 in the darkest skies The magnitude of planets varies as they move around the Solar System, mostly due to their varying distance from Earth. It is interesting to note that the magnitude of some stars can vary also, but once again that is an article for another time.

Notice how bright stars, particularly Sirius, sparkle and flash different colors while near the horizon. This is caused by our atmosphere being thicker and rather unstable near the horizon. Inexperienced star gazers almost invariably wonder if they could possibly be UFO's, particularly since the stars are close to fixed objects such as trees which makes the motion of the stars more obvious. Planets don't twinkle as much since they are tiny disks instead of dimensionless points of light, but even they will twinkle if the air is unstable enough. A few years ago, I was with two teenagers who spotted Venus very close to the horizon twinkling; first words out of their mouths were "Is that a UFO?"

I mentioned motion of the stars just now. The stars move of course because the Earth is rotating, but the results may not exactly match what you expect. Many stars rise in the east and set in the west – but some don't. At any given moment, there are a few stars moving west to east, unless you happen to live on the equator; and these same stars never set anywhere at any time!

As seen from the surface of the Earth the sky revolves around the North (or South) Celestial Pole, which is directly above our planet's North Pole. Any star less distant than the observer's latitude in degrees from the celestial pole never rises or sets and spins endlessly around in circles about the pole. These stars are called circumpolar. This is a little hard to understand if you have never seen it in action. Pick a constellation near the North Celestial pole like Ursa Major (the Big Dipper) in the Northern U.S. or Ursa Minor (the Little Dipper) if you don't. Look at it in the early evening and again near dawn – you'll see what I mean by circumpolar. You can also take the easy way out and just spin the disk around on your planisphere.

It just so happens that there is a star located almost exactly on top of the North Celestial Pole - Polaris; it is often said in casual conversation that all the stars in the sky revolve around Polaris. Not quite true but close enough for our purposes.

Now is the time to go outside and spend a few hours learning some constellations and names of the brighter stars. After you do this for a few nights you'll probably be pretty good at it.

After you get some practice stargazing in it will be time to read part II.