The Moon

A BRIEF INTRODUCTION OF OUR CLOEST COMPANION BY CHRIS SARA

Foreword

As by far our closest neighbour in an otherwise inaccessible Universe, the Moon, is a great place to begin our astronomical journey. Excepting the Sun, no other object in the Universe has such a direct effect on our everyday lives on Earth. It governs the tides, the speed we rotate, and through history we have relied on the ever-rhythmic lunar cycles to pace our lives.

During the formation of our galaxy, it is strongly believed that a collision between the Earth and Moon was responsible for the Earths tilt. This tilt is the reason we have seasons and has been a part of shaping the evolution of life on our world.

We have visited the surface many times, both physically and remotely, and return visits are slated for the near future. It offers many opportunities for scientific discovery and could be a launch pad for deep space exploration. We could base telescopic equipment on the far side of the moon; away from earths polluting noise, from light and atmosphere and where gravitation forces are low allowing us to build structures that would be ungainly on Earth. There is no doubt commercial value on the Moon and this could sadly be the catalyst for progress. The commercialisation of space is something that will arise and how we deal with it will be a reflection of how we managed our planet. This may not instil confidence in the future but there remains hope, as always.

Even our language reflects our feelings for the Moon, with words like “lunatic” and “moonstruck” a reference to our nearest companion. We have sung to about the Moon and animals have howled in its presence. We share a voyage around the Sun, tied to one another, wobbling our way through space and time. It is mystically the same size as the Sun in our sky and when they aligned people took it as a sign of doom, prophesizing and frozen awestruck. Mathematics can now explain these happenings, but nonetheless, our relationship is one of both science and romance, and definitely worthy of our gaze as astronomers.

The simplicity of observing the moon is something not to be undervalued, it is ever present and large. Conversely, it is a large source of light pollution when it comes to viewing things beyond its gaze, but that is an issue for other observations, and not a reason to avoid it’s wonder, for now.

Introduction

The moon is a single point of interest for astronomers. This means that we don't need the entire sky to be clear to do our observations. This is true for most observations of course, but with the Moon it is so prominent that even limited viewing conditions offer plenty. With certain clouds present there may even be enhanced photographic opportunities.

The Moon is at times very visible during the daylight hours. Should you be taking advantage of daylight observations it is important to be careful not to view the Sun with your equipment as the strength of the Sun can do permanent damage to your vision.

The Moon only requires the naked eye for basic observations and a reasonable pair of binoculars will offer excellent detail. It is full of detail when observed aided by a telescope, and spanning 0.5^{o} of arc it can soon fill the eyepiece. In its full moon phase, the magnitude of sunlight being reflected off its surface is quite obstructive to seeing details. In half and less phase, the effects of the shadows cast by the ridges create excellent images.

What is known about the moon is well documented and studying the surface offers plenty of entertainment. Finding the areas that mankind has explored gives you a sense of connection with our history in space exploration. It is also a good alignment object for aligning a GOTO telescope, or aligning your eyepiece and finder scope. There are definite pluses and minuses when it comes to the Moon in the night sky, but the Moon is the Moon and its presence is both vital to life on Earth and valuable to the night skies.

About the Moon

Basic Facts

Most of the planets have moons, but ours is the only one that is actually named, the *Moon*. It has been known as many things over time, the Romans referred to it as *Luna*, and the Greeks, *Selena*. It was officially named by the newly formed International Astronomical Union (IAU) in 1919. The name was chosen as it had already been widely used for millennia and that probably made sense being one of the first things the organisation did.

The Moon is 27% the size of Earth and the fifth largest moon in the solar system. It's size ratio of approximately 1:4 is the highest of any moon in relation to its host planet. This makes the relationship that the Moon has with Earth a special one. It creates a dependency on each other that ultimately means our fates are tied. The Moon is slowly moving away from the Earth and as we drift slowly apart our days will draw longer and our tides smaller. Moreover, if we are getting further apart then we were once closer together. We once had a day that was nearer 5 hours long and tides that were much larger.

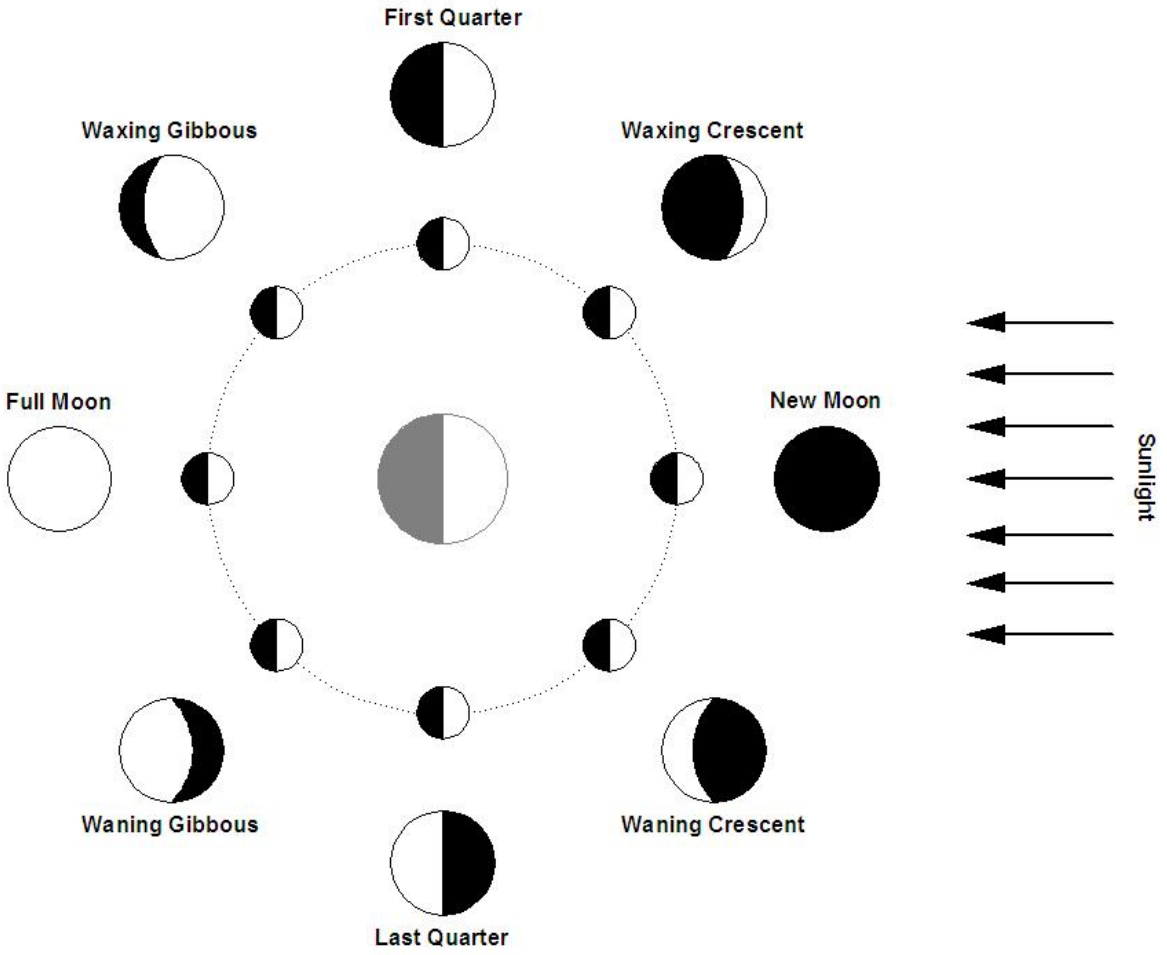
The length of our day is something that our evolution has been based upon. It is known as *circadian* rhythm and is based around our 24-hour day and internal clock relationship. As we move apart the days will grow longer with our reduced spin speed. Another effect of a slower rotation is the Earth becoming unstable and instead of having a small wobble we could have a large wobble. The Earth could even flip by as much as 90^{o}. Fortunately for us, like most things that happen in the Universe, this is happening very slowly.

We can learn to navigate our way across the Moon's surface like we do that of Earth. It will come and go every month so we will have many opportunities to make observations and

create images for our future study. This is one of the great advantages of the Moon over the planets, our next closest neighbours.

The Phases

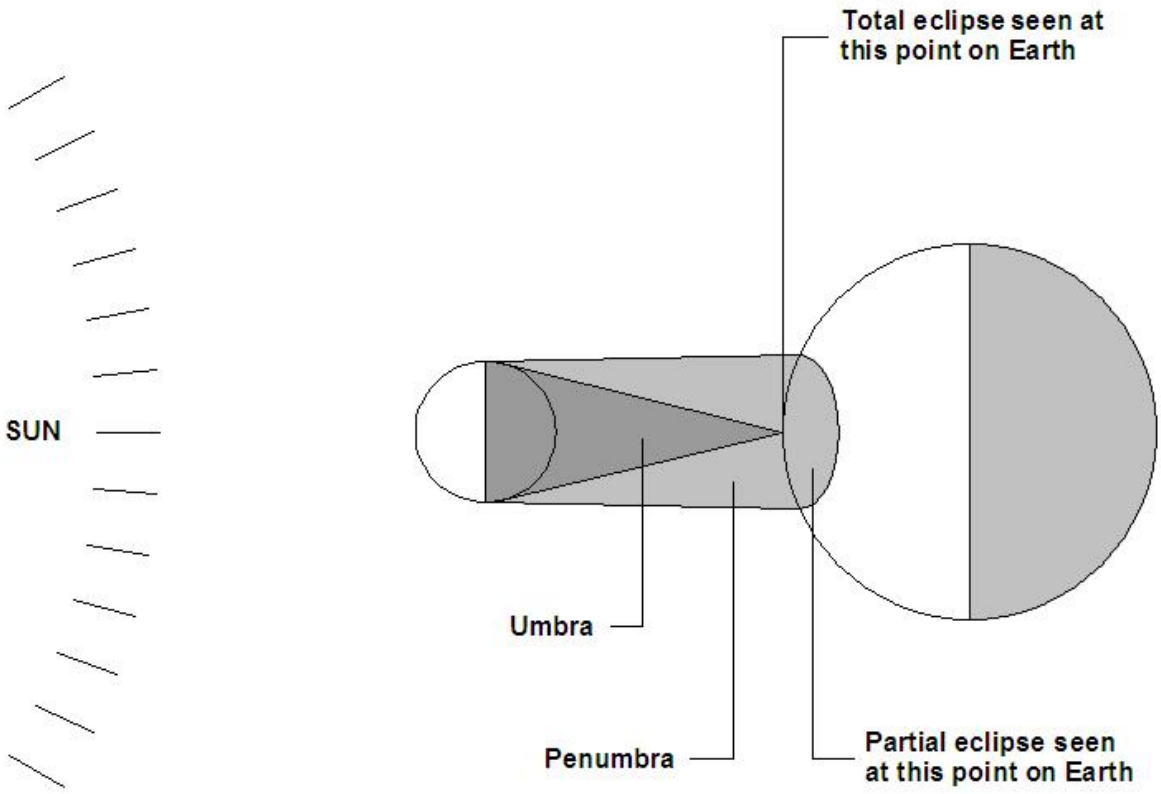
The Moon has a cycle, or phases, that it passes through over the period of a month, or approximately 29 days. These phases dictate the amount of the Moon surface illuminated by the Sun. The Moon will phase from new, to first quarter, to full, to last quarter, and back to new. Each of these phases last approximately one week and the change is defined as waxing, increasing magnitude, and waning, decreasing magnitude.



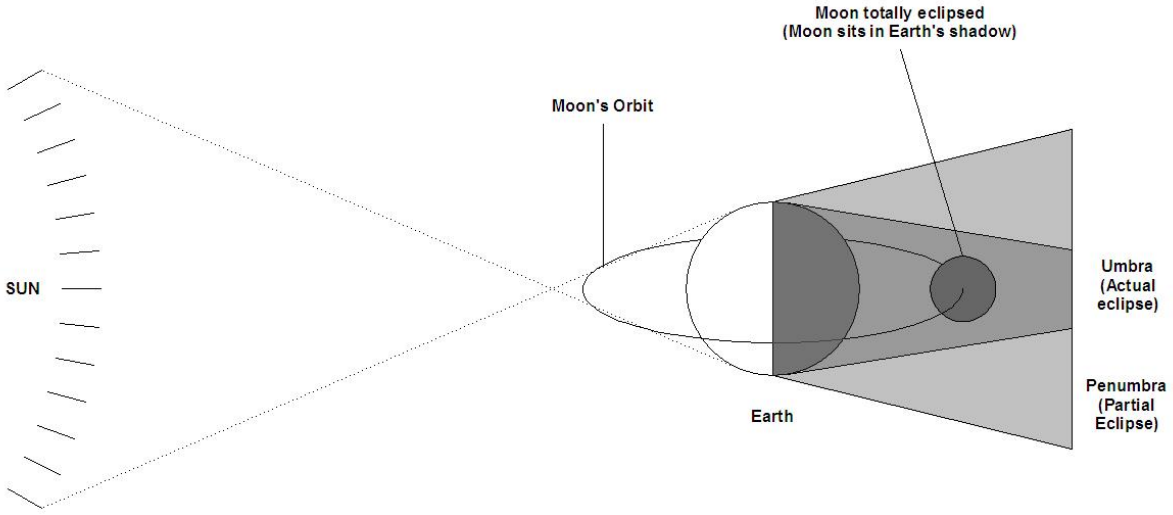
Solar and Lunar Eclipses

On rare occasions the Moon will undergo a state of eclipse. This is when the Moon is:

- obscuring our view of the Sun from our viewpoint on Earth, known as a *"solar eclipse"*.



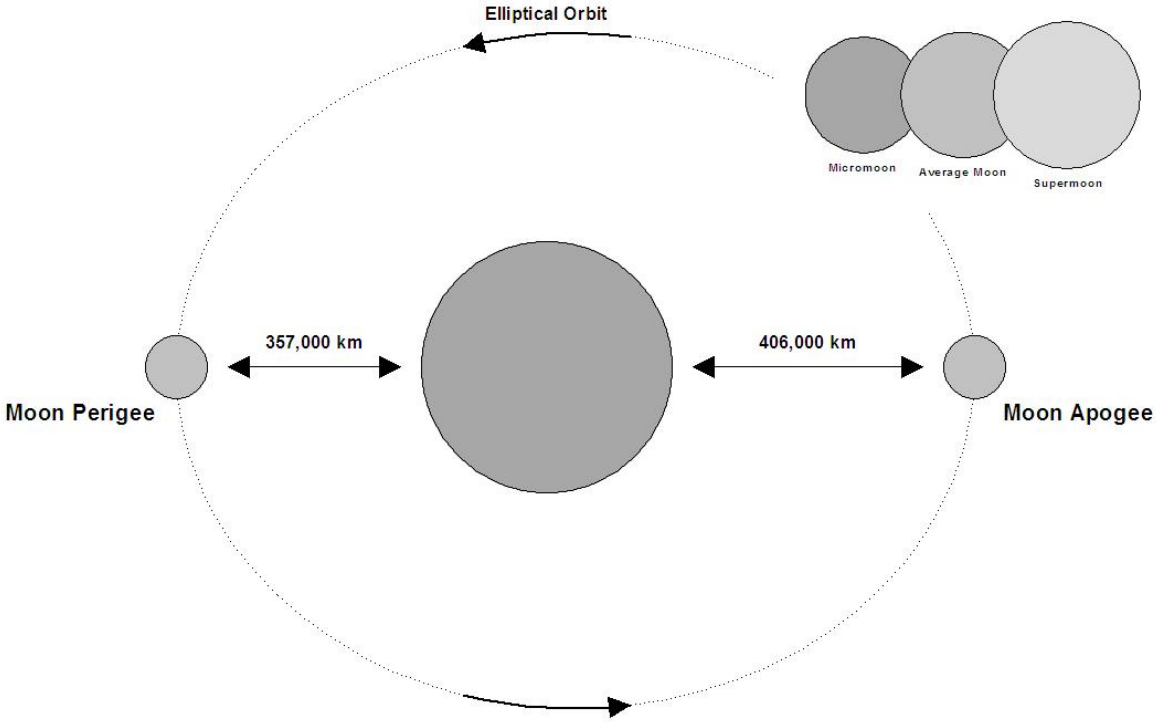
- Or the Earth obscures the light from the Sun hitting the surface of the moon resulting in a *"lunar eclipse"*.



A lunar eclipse lasts longer than a solar eclipse. There are also partial and hybrid eclipses. A total solar eclipse is a rare event as it requires the Moon and Sun to be perfectly aligned. Be mindful when observing an eclipse that when the Sun reappears it could damage your eyes.

The Earth Moon Dance

The Moon has an elliptical orbit around the Earth and when it is in a full moon phase at its nearest to the Earth it will appear around 14% larger and 30% brighter in the sky. This is referred to as a Supermoon, not a scientific term, but one coined by astrologer Richard Nolle in 1979.



The Lunar Landscape

The Moon has a very thin atmosphere leaving the surface exposed to the ravages of space. However, this means there are no weathering effects as we see on Earth and other planets in our solar system. Time is frozen and we can observe the effects of billions of years of bombardment. Various trips to the surface of the Moon have returned rocks; rocks that give clues to the age of the Moon, Earth and solar system, and ultimately contribute to explaining how the solar system came to be.

Features

The most obvious features on the Moon's surface are the bright areas, known as *highlands,* and the dark areas, known as the *maria*.

My first astrophotography image. Using a 10" Dobsonian Telescope and iPhone

Since the Earth and Moon are tidily linked, we only see the one side of the Moon; the near side. With the far side – oft referred to as the *"dark side of the Moon"* – always hidden.

The Highlands
The bright areas we observe are the remains of the original surface of the Moon after it cooled. The lighter elements, such as aluminium and silicates, floated to the top as the surface solidified. The surface of the Moon was subsequently subjected to asteroid and meteor peppering, a period known as the heavy bombardment. Over time this constant attack resulted in large crater formations that rise high from the surface. They formed mountains and ridges that we observe when the sunlight hits the surface at an angle, casting shadows that show wonderful detail. Surface cracking also occurred and more magna flowed from the core and solidified on the surface, forming the maria.

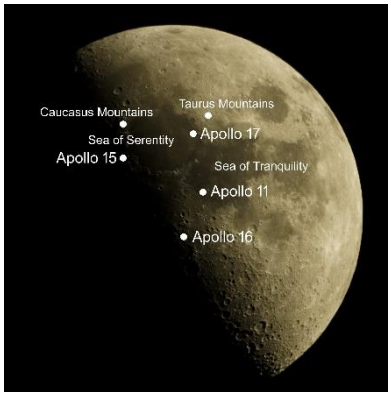
The Maria
Latin for seas, the maria were thought to be oceans of water, but in reality, are solidified magna that give rise to their dark appearance. They show much less damage than the highlands as the heavy bombardment had passed as they solidified. Maria accounts for some fifteen percent of the Moon surface.

Closer examination of the highlands and the maria reveal other features. There are *Rilles*, cracks in the surface most likely due to volcanic activity, *Domes* formed from thick solidified lava flow, *Wrinkle Ridges* and *Grabens* found mostly within maria caused by tectonic activity.

Regolith
The outer layer of a planet or body is referred to as the *Regolith*. On Earth this is our soil, rock, ash and glacial drifts. On the Moon it is comprised of the crust that has be pummelled over its entire life, and resembles a fine powder likable to that of caster and icing sugar.

There is also some residue magnetism trapped within the rocks, an indication of the once molten core that existed for the first 2 billion years of the Moons life. A thin atmosphere is also present, but it is some 13 magnitudes ($x10^{-13}$) less than Earth's, so leave your helmet on.

Map of the Moon
Just like on Earth we can map the surface of the Moon. Regions and features have names as they do on Earth. Terms such as Mons, for mountains, and Mare, for seas are commonplace and there are the US Apollo landing sites and the Soviet Luna mission sites. Numerus craters are clearly visible but there are limits to how small an object can be resolved from our vantage point on Earth. We can not see any manmade objects left behind from our visits but maybe in the future we will have objects that we can see. Until then, we need to be happy with the natural beauty of the Moon.



Summary

When you are new to astronomy the Moon is a great point to start your observations. It is full of interesting features and very easy to view. The relationship we have with the Moon is an important part of our journey to uncovering the secrets of the Universe. It will hopefully provide us greater access to the solar system by offering a place to rally; on our way to the planets and stars, or even as a permanent home in its own right.

At times the Moon may seem to be in the way, so bright that less prominent objects struggle to shine, but for many days of the month it is invisible or very passive. I find myself looking forward to its return from *new* so I can align my telescope with ease and play with my cameras, which can be hard to use on everything but the Moon.

There are many sources for information on our Moon, this is a brief guide from my limited understanding. Venture out and learn more and may the Moon be a source of wonder and joy in your astronomy journey.

Moon Rise over Foveaux