Lunar Views:
All Craters Are Not Created Equal

"We hold these truths to be self-evident, that all men are created equal, ...". What is also self-evident with even a quick study of the Moon through a telescope is that all craters are not created equal. If you look closely, you will see craters that look like cups and craters that have mountains in the center. What may not be quite so evident is that even the large flat-bottomed circular basins that you see are a type of crater called an impact basin. Another interesting thing to note is that all craters are essentially circular.

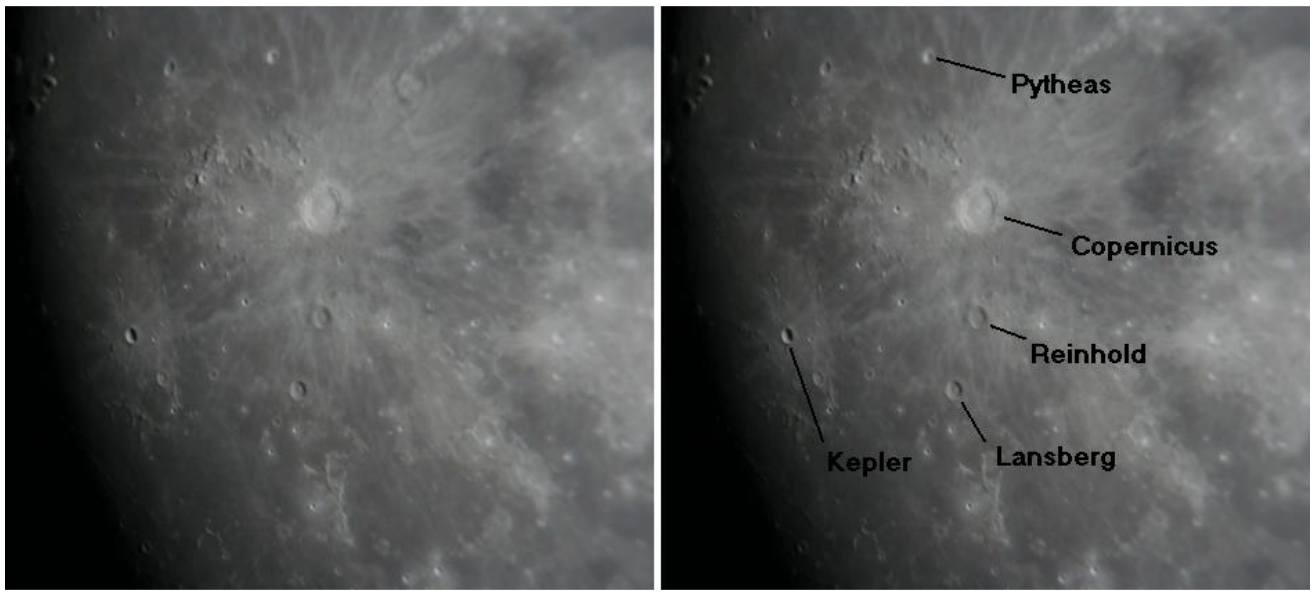
Many studies, both theoretical and experimental, have been done to help understand why craters come in three different classes. What has been discovered is that depending upon the amount of energy an impactor has before it hits, and the characteristics of the object it is hitting, the craters left after the impact will indeed come in three types. These causes not only determine the shape of the crater, but also its size. These studies have also shown that craters should be circular regardless of the angle of impact, except for extremely low angles. This seems like a very surprising, almost counter-intuitive result. But, by looking at the moon, this does indeed seem to be the case. If a crater is non-circular at all, it is usually because another crater that was formed later has modified its shape.

The class of craters that appear cup-like with nice round floors and short rims are also the smallest class of crater. They are referred to as simple craters. A look at almost any spot on the moon under higher magnification will reveal many simple craters. Simple craters on the moon range up to 15 to 20 kilometers in diameter.

Craters larger than this do not have a cupped bottom. Instead, they usually have a central peak and terraced inner rims. Now, you will see large craters on the moon with very flat bottoms, but this is because magma has welled up from below and filled the basin, settling into a flat-surfaced "lake" and

solidifying. Rest assured that when the crater first formed, it did indeed have the characteristic complex shape. Complex craters can be up to 200 kilometers in diameter.

Copernicus is a fine example of a complex crater, shown in the photo below taken when the moon was 11 days past new. A bright spot appears where the central peak is, and the terraced walls can be seen. Copernicus is one of the freshest complex craters, formed roughly 1.1 billion years ago. Because of its youth, there has not been a lot of cratering since its formation. Consequently, its beautiful,



extensive mantle of ejected material is very evident. This mantle spreads out for hundreds of miles in all directions. Copernicus is about 95 kilometers (56 miles) in diameter, and its walls stand an impressive 3760 meters (11,400 feet) above its floor.

Many other craters can be seen in the vicinity of Copernicus, both complex and simple craters. Pytheas and Kepler are on the border of simple versus complex craters, while Lansberg and Reinhold are a few examples of small complex craters.

Larger impact event structures are called basins. These can be 300 to 2,500 kilometers in diameter. A fresh impact basin is characterized by not one, but several rings of ridges left after impact. However, most impact basins have been so heavily modified after their formation that the multi-ringed structure is

not easily recognizable. The best example, Mare Orientale, is barely visible from Earth, and then only during favorable librations. Lunar spacecraft have provided us with beautiful images of it though, one can be found on the Internet at: http://antwrp.gsfc.nasa.gov/apod/ap960112.html. On our side of the moon, Mare Crisium shows about the best hints of a multi-ring structure.

Take a look at the moon and see if you can make out impact structures from each of the three classes: simple, complex, and impact basin. Imaging what our planet would look like if the forces of water, wind, and plate techtonics had not wiped out almost all traces of the cratering that took place here on Earth.

You are welcome to contact me by email at doug@ShoestringAstronomy.com, and view some of the astronomical fun I have at www.ShoestringAstronomy.com