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The Moon

Ken Tapping, 26th February, 2019

One of the images sent back by the Chinese Longjiang-2 spacecraft shows the far side of the Moon, a monochrome, heavily cratered disc, and in the distance the Earth, a blue disc with white clouds. It is hard for the two objects to look so different, since they have so much in common. Even though the Moon is one of the easiest objects to observe, it is one of the most puzzling.

Firstly it is big. It has a diameter of 3,475 km, compared with the Earth's 12,756. The Moon's diameter is over a quarter of the Earth's. There are larger moons in the Solar System, such as the four largest moons of Jupiter, or Titan, the largest moon of Saturn. However, Jupiter and Saturn are huge planets, and their largest moons are less than 4% the diameter of the planets they orbit. This has led to the Earth-Moon system being often referred to as a "double planet". How this arrangement came about is still an open question.

The Solar System formed around 4.5 billion years ago from the collapse of a cloud of dust and gas. It formed a rotating, shrinking disc, with a big lump forming in the middle, which became the Sun. In the surrounding disc, smaller discs formed with the planets building up in their centres, and their moons from what was left over in their birth discs. This approach always leads – as far as we know – to a big lump with lots of small lumps orbiting it. This mechanism nicely explains the moon systems of the other planets, and of course the Solar System itself, but not the Earth-Moon double planet. The Moon should be far smaller than it is.

The idea getting a lot of attention at the moment is that a planet was well in the process of forming when another planet smashed into it at many kilometres a second. The two bodies were pulverized, forming a spinning cloud of dust and fragments, which eventually collapsed to produce two bodies, the Earth and Moon. This could also explain why the plane of the Moon's orbit around the Earth is at angle to the plane in which the Earth and other planets orbit the Sun.

The Earth and Moon probably started out with basically the same mixture of ingredients. However, whereas both the Earth and Moon started out as hot, molten rock balls, the Earth had enough mass to gravitationally hang onto its atmosphere and the water vapour in it. The Moon, being less massive and with weaker gravity, could not, and its atmosphere was lost into space. So today it is an almost airless, dry rock ball that bakes during the lunar day and freezes at night.

When the inside of the Moon was still soft, the slightly stronger pull of the Earth's gravity on the side facing Earth than the pull on the lunar far side pulled the Moon out of shape, making it slightly egg-shaped with the long axis pointed at the Earth. This continuous shape change as the Moon rotated turned the energy of the Moon's rotation into heat, slowing that rotation until eventually the Moon became locked, with the same side of the Moon facing the Earth all the time, like two whirling dancers holding hands and facing each other.

There is another lunar puzzle. Our side of the Moon consists of old, cratered areas and huge plains formed from huge lava flows. These are darker than the surrounding terrain and form the well-known face of the "Man in the Moon". The side facing away from the Earth has much smaller lava plains and is mostly craters. We do not yet have a good theory as to why the two sides of the Moon are so different. It is intriguing to think that today, as we probe the depths of space and time, there is still much we do not know about the Moon.

Look for Mercury, the closest planet to the Sun, low in the west after sunset. Mars lies in the southwest after dark. Jupiter lies low in the south in the predawn sky, with Saturn to its left and Venus shining brightly in the dawn glow. The Moon will reach Last Quarter on the 26th.

Ken Tapping is an astronomer with the National Research Council's Dominion Radio Astrophysical Observatory, Penticton, BC, V2A 6J9.

Tel (250) 497-2300, Fax (250) 497-2355

E-mail: ken.tapping@nrc-cnrc.gc.ca

