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## THE DOUBLE PLANET

Ken Tapping, 27<sup>th</sup> March, 2018

Our Moon might only be the fifth largest moon in the Solar System, but it is unique. It has a diameter of 3475 km, compared with the Earth's 12,756 km, so the Moon has a diameter that is 27% of the diameter of the planet it orbits. The four larger moons are Saturn's moon Titan, with a diameter of 5550 km, and Jupiter's moons Ganymede (5262 km), Callisto (4820 km) and Io (3643 km). However, Titan's diameter is only about 5% of Saturn's 120,540 km diameter, and Ganymede less than 4% of Jupiter's 142,980 km diameter. This has led to the Earth-Moon system being often referred to as a "double planet". How did this situation come about?

The Solar System was born from the collapse of a huge cloud of cosmic gas and dust. It formed a disc, with the centre collapsing to form the Sun. In the rest of the disc, several "mini-discs" formed, with their centres condensing to form the planets. In their discs, some "mini-mini-discs" condensed to form their moons. That idea works well for all the planets – except the Earth. That process would have left us with maybe a tiny moon or two, probably none at all for a small planet like ours. At the moment we still don't know for sure, but a widely-held theory is that there was a collision.

During the early days of the Solar System there were assorted objects moving in random orbits, resulting in collisions. This was an important part of how the planets grew. Generally, by the time the growing planets had achieved some size, most of the badly-behaved big objects had been swept up and had been already incorporated – except for at least one. It has even been named: Theia, after the Greek goddess of sight, and mother of Selene (the Moon), Helios (the Sun) and Eos (the Dawn).

The Earth is believed to have achieved something like planet status 4.54 billion years ago. Then, 4.51 billion years ago Theia, a body about the size of Mars (around 6500 km diameter) smashed into it at a speed of many kilometres a second. Parts of

Theia and Earth were blasted off into space, where they formed a belt which gradually combined together to form the Moon. This could explain why the Moon seems to be a pastiche of assorted bits.

Tidal forces long ago locked the rotation of the Moon so that one side faces us all the time. So until 1959, when the Soviet spacecraft Luna 3 shot behind the Moon and took pictures, we had no idea what the Moon's far side looked like. We expected it to be much like the side we see. It wasn't. Our side shows huge lava flows covering much of the surface; the other side is mainly mountains and craters. Thanks to the Apollo space missions and assorted lunar orbiters, we know that the Moon's crust is much thinner on our side than it is on the far side. That may explain the huge flows of lava out onto the surface facing us. This is thought to be due to the Moon having formed from material from two different bodies.

If you have never looked at the Moon through binoculars, or better still, a small telescope, then you really should try it. It's best to observe when the Moon is not Full, so the Sun is lighting part of the lunar surface at a low angle. Those huge, dark lava flows stand out, along with countless craters of all sizes. If you look carefully, you will see the mountains are mostly walls of old, huge craters, not like mountain ranges here on Earth, produced by plate collisions. As far as we know the Moon has never had any plate tectonics. It's best to observe the Moon when it is high in the sky, but if you have a clear horizon, get out the telescope and watch the Moon rise. Seeing the mountains, lava flows and craters coming up behind the trees is a fascinating and beautiful sight.

Venus lies low in the sunset glow. Jupiter rises about midnight, Mars and Saturn, close together, around 4am. The Moon will be Full on the 30<sup>th</sup>.

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