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## JUPITER

Ken Tapping, 9<sup>th</sup> January, 2018

Jupiter, the fifth planet out from the Sun, is the largest body in the Solar System after the Sun. It has a diameter of 143,000 km compared with our world's 12,756 km, and the mass of 318 Earths. That is, Jupiter has about 1400 times the Earth's volume but only 318 times the Earth's mass. Earth is made mainly of rock surrounding a core of nickel and iron. To be so big yet have such a low mass, Jupiter has to be mainly gas, maybe with a small rocky lump in the middle. Planets like Jupiter are referred to as "Gas Giants", as opposed to "rocky planets", like Earth. It is interesting that whether we are making a star, a gas giant planet or a rock ball like Earth, we start with the same recipe, the gas and dust mixture forming the cosmic clouds between the stars. Most of the material in the universe resides in these cold, dark clouds.

The story starts when a cloud collapses. It forms a disc, which then coagulates into a number of lumps of various sizes. If the amount of material being added to a lump is sufficient to heat and compress the core enough for nuclear fusion to start, then the body becomes a star. If that threshold is not reached, the body becomes a planet, gradually cooling off until its temperature is dictated by the brightness of the star it orbits, and how close it lies to that star. If it lies close, the heat, light and wind from the star will drive off most of the gases and other volatile materials, leaving rock balls like Mercury, Venus, Earth and Mars. If the young planet lies far from its star, it may hang onto the gases and volatile materials it inherited from the birth cloud, making it a gas giant planet.

Jupiter is a great planet for observation with small telescopes. Even binoculars will show it as a tan coloured disc, together with starlike objects in line with it. These are its four largest moons, Io, Europa, Ganymede and Callisto. A small telescope will show the disc to be crossed with darker bands, and a reddish oval known as the "Great Red Spot". By watching features such as the Great Red Spot

it is easy to show Jupiter rotates once on its axis every 10 hours or so. This means features on the planet's equator are moving at over 45,000 km/h, compared with around 1600 km/h for the Earth. This furious rotation pulls the clouds into belts and drives ferocious storms. The Great Red Spot is a storm bigger than the Earth that has been there for centuries. There are videos of Jupiter's clouds and storms to be found on the Internet, based on observations by the various spacecraft that have orbited or flown past the giant planet. The huge amount of energy in Jupiter's atmosphere drives enormous lightning storms, which we have seen from spacecraft. It is unlikely we will get personally close to this planet because it has an intense magnetic field that is trapping huge numbers of high-energy particles. These radiation belts are far more intense than those surrounding our world. We can safely pass through ours, whereas the radiation levels around Jupiter are so high even robot spacecraft have to be radiation-hardened.

The reds, browns, tans and greys we see in Jupiter's atmosphere are due to organic – carbon based – chemicals, formed from reactions between the ingredients of the cosmic material from which the planet formed. Many of them are believed to form the basis for life. It is likely that these same chemicals were present on Earth when it formed 4.5 billion years ago, and they helped spark the beginnings of life on our world.

There is little chance we will ever "land" on Jupiter; even if there were a solid object in the middle, the pressures would make it unreachable. However, robot balloons floating in the planet's atmosphere could tell us a lot about that huge world.

Jupiter and Mars lie close together in the Southeast before dawn. Mercury is low in the dawn twilight. The Moon will be New on the 16<sup>th</sup>.

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