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WHERE ARE WE FROM?

Ken Tapping, 17th February, 2015

It is cold and dark out here, and has been so for over four billion years. The Sun is just a usually bright star in a permanently black sky. There are worlds here; mainly small ones a few kilometres across or smaller. Most of them are too small for their gravity to pull them into spheres. At temperatures of -250C or less, most gases are either frozen solid or liquid. Ice is a permanently frozen rock mineral. These worldlets are mostly airless, cratered rocks. On a particularly mild day puddles of liquid gases like neon might bubble gently on their surfaces. We are in the outer Solar System, beyond Pluto, roughly 30 times further from the Sun than Earth. At that distance the sunlight has around 1% of the intensity we receive on the Earth. Here, at the edge of the Solar System, are objects that will help us understand a little better how we came to be here.

In 1930 Clyde Tombaugh discovered Pluto, which was promptly awarded the title of outermost planet in the Solar System. However there were some questions regarding this. Firstly, Pluto's orbit crosses Neptune's; all the other planets stick to their own lanes. Secondly Pluto is small, only about two thirds the diameter of the Moon. In addition, objects that small, or smaller, are extremely hard to spot at that distance; there could be more objects like that out there. Now we know there are, thousands or even millions of them. They are members of what we call the Kuijper Belt: named after Gerard Kuijper (pronounced Ky-per).

These hard-to-see and hard-to-get-to objects have become a subject of intense interest among scientists. We believe Pluto and the objects in the Kuijper Belt are deep-frozen, preserved lumps of the raw material from which the Solar System and we were made, some 4.5 billion years ago.

We really want to know where we came from. We have parts of the story. After the Big Bang, almost 14 billion years ago, hydrogen gas formed, providing the raw material for making stars. These in turn produced energy by nuclear fusion: converting hydrogen into all the other elements. These "nuclear waste products" were returned to space when those stars died, providing a complete set of chemical elements, just what was needed for the next stage. In dark, cold clouds, over millions of years, these elements reacted with each other, making chemicals like water, ammonia, alcohol, hydrogen cyanide, formaldehyde and a host of other compounds relevant to life as we know it. Also, we know that these can react together to make aminoacids, the building blocks of life. However, there is a gap. How do those substances wind up on a planet, available for making living creatures?

Forming stars and planets is a dramatic process, with lumps of stuff colliding with other lumps of stuff and becoming molten balls of rock. Then a nearby star turns on and floods its neighbourhood with radiation and heat. Those chemicals important for life would have been destroyed, so what happened? It seems that while the Earth and other inner planets were masses of molten rock, the lumps in the outer Solar System formed more slowly and stayed cold. When they were deflected into the inner Solar System afterwards as comets they delivered consignments of organic chemicals to the Earth and other inner planets at a time they were cool enough to use them. That is why we turn our telescopes on every comet that visits us, to see what it is made of and how it works, why we sent the Rosetta spacecraft to a comet and have landed a probe on it. It is also why, this summer a spacecraft from Earth will fly close to Pluto and some other Kuijper Belt objects and continue on into the outer Solar System. It's all part of getting a better picture of how we came to be here.

Venus lies in the southwest after sunset, with Mars close by and much fainter. Jupiter dominates the southern sky overnight and Saturn rises around 3am. The Moon will be New on the 18th.

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