

Science, The Spoilsport!

A primitive tribe that lives by hunting has a very wonderful explanation for the phenomenon of night. They believe that to enable them to sleep, God covers up the dome of the sky with a cover made of leather. The stars are the sunlight, leaking through holes in the cover!

Early human beings, in different corners of the world, had many such ingenious explanations to explain nature. But behind all of them was the core belief that mankind is very important. 'We' are the centre of the Universe and therefore God, the creator, takes special care of us! The whole universe revolved around the Earth!

Then came science, the spoilsport.

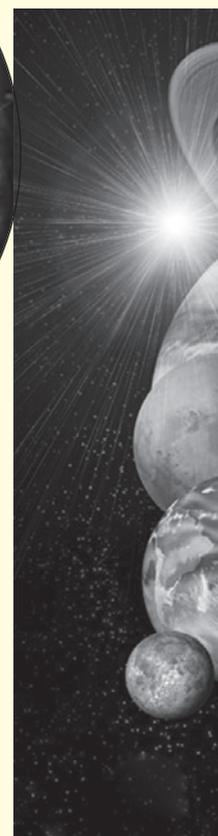
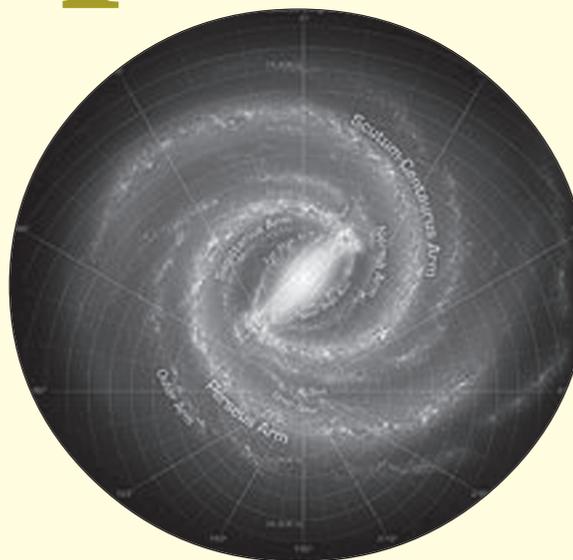
The Indian astronomer Aryabhatta (475-550AD) knew that the planets revolved round the Sun. They had no light of their own but shine by the reflection of the light of the Sun. He also had correctly surmised that the apparent rotation of the stars was due to the earth rotating on its axis, rather than the sky rotating, as was widely believed the world over.

But it was only in 1543, when the Polish scientist Nicholas Copernicus published his book *On the Revolution of the Celestial Spheres*, where he argued that we are only a planet of the solar system going round the sun, not the other way round, that the world came to know of the theory. It created quite a storm.

Many of you may be aware of how the pioneer Italian scientist Galileo Galilei had to spend years in prison for writing a book, in which he rightly defended the Polish scientist. Galileo escaped the death sentence by ultimately admitting that he had been wrong, such was the pressure of the church on him! An earlier scientist, also from Italy, Giordano Bruno was not so lucky. He was burnt at the stake, for the same views, which he refused to recant.

But the winds were changing in favour of science. Late in the 17th century, when Isaac Newton, with his Theory of Gravitation decisively proved that Copernicus was right, we got dislodged from the centre of the planetary system. Not only that, we found that our planet was a middle sized one in our solar system itself. The giants Jupiter and Saturn could swallow 1400 and 830 Earths respectively! Our self-importance came down two notches.

Anyway, we were very proud of our own bright glowing star, the Sun, the giver of all life. It could hold one million Earths! Then increasingly powerful telescopes opened up the sky to the astronomers. The telescopes not only worked in the visible range but newer versions have now come up that covered the whole electromagnetic spectrum: radio waves, infrared, ultraviolet, X-



rays, gamma rays. With naked eye, we can see around three thousand stars. With telescopes, the number went to thousands, then millions and now billions. Science broke another myth. Our Sun, far from being an important star was a middle-aged star, of a size that was insignificant in front of real giants. The biggest, VY Canis Majoris, could eat up 8 billion suns – a mind-boggling number!

More was to come. Our planetary system was at one far edge of a huge conglomeration of 200 billion stars – the Milky Way Galaxy. We were not even near its centre. Our planetary system itself was an unimportant member of our galaxy! As we studied the sky in more and more detail, it was discovered that there were around 200 billion such galaxies in the known Universe. The biggest galaxy, IC 1101 can gobble up 200,000 Milky Ways! Even our galaxy turned out to be nothing extraordinary.

We were slowly but surely losing our importance. We are inhabitants of a small planet (Earth), which is a modest sized member of an ordinary planetary system (the solar system), with an ordinary middle class star (Sun), located at a remote corner of an ordinary galaxy (the Milky Way)! We were nowhere as eminent, as we used to think of ourselves!

But still we had one thought that gave us pride. We were the only intelligent species in the whole universe. Brandon Carter, Robert Dicke and some other scientists came up with the anthropomorphic principle. Their principle argument is that the

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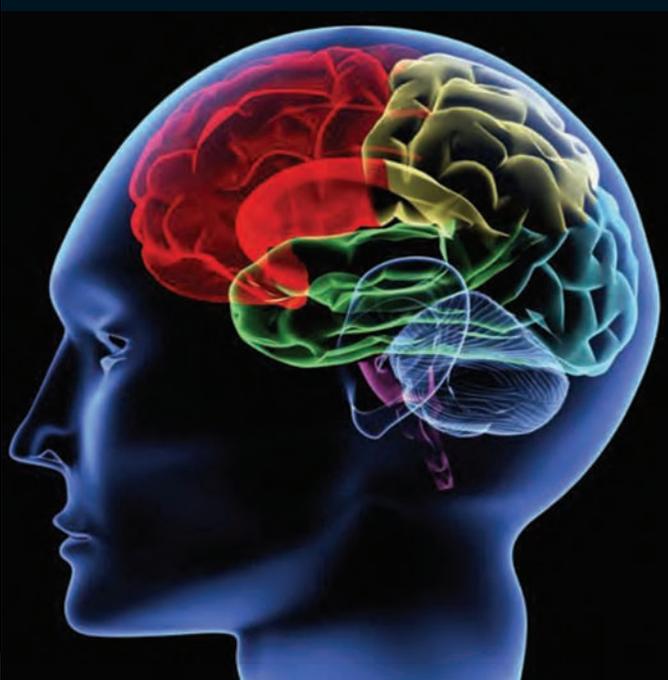
universe has been fine tuned so that only we can exist. The factors like age of the universe, the density of matter in the universe, the value of the fine structure constant which characterizes the strength of the electromagnetic interactions, the strength of the nuclear forces which hold together the nucleus, are such that it permits formation of commonly found matter and subsequently life as we know it. They have shown that if even a minor change in these values were to be made, life would not arise. Though there is a lot of strength in their argument, but it does not, *per se*, rule out life elsewhere.

In our own Solar System, there is a possibility of some type of primitive life form in some of the planets or their satellites, but our supremacy is not threatened. But now with space telescopes like the Hubble, the Chandra (named after the Indian Nobel Laureate S. Chandrasekhar), and the Kepler in place with more sophisticated detection and analysis tools,



scientists have discovered, as on date, around 800 such earth-like planets (called exoplanets) where in principle life is possible. They have also found that the universe has millions of free moving planets not connected to any star. Unfortunately, all these planets are so far off, that it may be quite a few more decades when we would be in a position to know whether they do harbour life. And whether that life is intelligent.

In 1961, Frank Drake, Emeritus Professor of Astronomy and Astrophysics at University of California, Santa Cruz, USA came out with an equation to estimate the number of extra-terrestrial civilizations in the Milky Way galaxy. It is given below, along with the meaning of the terms and Drake's original estimates of the values in brackets.



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Number of extra-terrestrial civilizations in the Milky Way galaxy, $N=R*F_p*N_e*F_l*F_c*L$, where
R= average rate of star formation in a galaxy per year (1/year)
F_p=fraction of these stars having planets (0.2-0.5)
N_e=average number of planets that can support life out of above number (1-5)
F_l=fraction of planets which actually develops life (1)
F_i=fraction of the above number, which develops intelligent life (1)
F_c=fraction of above, technically competent to send detectable signals (0.1-0.2)
L= length of time the civilization will last to send detectable signals (1,000-1 00,000,000)

Original estimates showed N is almost equal to L. The equations have been much debated and various modifications have come up over the years, giving different values of N. One productive outcome of this equation was that, a programme called SETI (Search for Extra Terrestrial Intelligence) was started in 1985 in USA. In this programme, using radio telescopes all over the world, scientists have been listening for any intelligent signal from space. But unfortunately, till date, no conclusive evidence of intelligent life has been found.

In the coming decades, science may be successful in getting such data. We may find that there are intelligent species like us or, what will be worse, more intelligent than us, somewhere out there. If so, that will be the final nail in our coffin – we will become ordinary citizens of the Universe!

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