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A GREENHOUSE ON VENUS

Ken Tapping, 15th April, 2014

Venus has often been called the Earth's twin sister. It is a rocky ball, almost the same size as Earth, has a thick, cloudy atmosphere and its orbit is the next one in from our world's. It is covered with highly reflective clouds, which make it by far the brightest planet in our skies. At the moment it is lurking in the dawn twilight, but when seen against a dark sky it looks like an escaped aircraft landing light. Over the last couple of decades we have come to realize that although it looks beautiful in the sky, it is really more of an ugly sister. Its surface has a higher temperature than the planet Mercury, the closest planet to the Sun, and the atmospheric pressure at its surface is about 90 times the pressure we experience here on the Earth's surface. Venus rotates very slowly, producing a day that is about 240 days long. It is probably one of the places in the Solar System we are very unlikely to send manned space missions. The cause of the hostile Venusian environment is a runaway of the greenhouse effect.

When we apply heat to something, it gets hotter. As that happens, it radiates increasing amounts of heat, mainly in the form of infrared, until it is losing energy at the same rate as we are applying it. At that point the object's temperature stops rising. We can drive up the temperature further by either applying heat at a higher rate or making it more difficult for the object to lose it. This is the greenhouse effect. A good example is what happens in your car when it spends an hour or two in the sun on a summer's day, and you find it too hot to get into. Solar heat has a short wavelength and easily passes through the windows. The surfaces in the car get hot and radiate heat at longer wavelengths, which cannot as easily escape through the windows, so the car interior has to get hotter before it reaches equilibrium.

This happens on planets too, and on the Moon. Although there are huge changes in temperature during the lunar day, the average temperature of the Moon's surface is about -50C. The Earth lies at

more or less the same distance from the Sun as the Moon, but our world is a lot warmer, with a surface covered with liquid water. The reason for this is the greenhouse effect. Atmospheric gases like water vapour, carbon dioxide and methane partially block infrared radiation coming up from the ground while letting solar heat get to the ground unimpeded. We have the greenhouse effect to thank for our planet being inhabitable.

About four billion years ago, when life first appeared on the Earth, the Sun was about 30% dimmer than it is today, but thanks to a higher concentration of greenhouse gases in our atmosphere, there were liquid oceans and a good environment for living things. As the Sun brightened, living creatures removed the greenhouse gases, locking them up in biomass and huge thicknesses of limestone rock, keeping the Earth comfortable for life.

It could be that the young Venus was very like the infant Earth. There may have been liquid oceans and comfortable temperatures. It could be that living creatures never appeared on Venus, or if they did, they could not remove greenhouse gases from the atmosphere fast enough to stabilize the temperature, so the greenhouse effect ran away, any living creatures were fried and any carbon dioxide locked up in biomass or limestone rock was released. Today Venus's atmosphere is about 95% carbon dioxide and thanks to the greenhouse effect, the planet developed its horrible environment, with a surface temperature of 460 C. So far no spacecraft we have landed on its surface has lasted more than an hour or so. Venus might look bright and beautiful in the sky, but it is one of the most unpleasant places in the Solar System.

At nightfall, Mars lies in the southeast and Jupiter in the south west. Saturn rises around midnight. The Moon will reach Last Quarter on the 21st.

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