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THE END OF THE UNIVERSE

Ken Tapping, 27th December, 2016

How will the universe end? Once we were not sure whether it would, but now we know there is an unknown something, which we are calling "dark energy", which is driving the expansion of the universe faster and faster. We see nothing that is likely to stop our universe expanding forever. However, there is something that is likely to bring down the curtain in the distant future. Moreover, it is something we have known for at least 160 years and most of us have encountered in physics class: "The Second Law of Thermodynamics". One of the statements this law makes is that heat flows from hot objects to cold ones, never the other way. Moreover, any process using energy wastes some, so reversing a process might be impossible, or if it is possible, requires even more energy. The work required to put the Genie back in the bottle is always more than we obtained by releasing him.

Stars are concentrated sources of energy, which they radiate in all directions out into space. Some of it warms the Earth. The Earth then reradiates that energy, along with the heat from its core and that produced by our activities. It all ends up distributed throughout space in such a rarefied form that it cannot be used for anything.

Eventually the universe will run out of hydrogen for making new stars, and one by one the surviving stars will run out of fuel and cease shining. Then, gradually, everything will cool to the same temperature and anything driven by a flow of energy, like living creatures, will come to a stop.

At the moment the universe has an average temperature of about 3 degrees Kelvin, which is minus 270 degrees Celsius. Zero degrees Kelvin, or minus 273 Celsius, marks a total absence of heat energy. There is no lower temperature. That's why we call that temperature "absolute zero".

The output of all the stars over all their lives will hardly increase the temperature at all, so when the stars are gone the universe will be dark and very cold. That won't be the end of the story; eventually the particles making up the atoms in that frigid universe will decay, and the universe will end. It will be all over… or will it?

Throughout history we have had repeatedly to expand our ideas and diminish our sense of importance. Once we believed there was just the Earth, surrounded by "The Heavens", with of course humankind at the centre of everything. Then we were demoted to just one of several planets orbiting the Sun. Later we found the Sun was just one of billions in a spiral galaxy we call the "Milky Way". Now we know the Milky Way is but one out of billions of other galaxies, extending out as far into space as we can see with our telescopes. These galaxies are all embedded into a big ball of space-time we call the universe. Now an increasing number of physicists are taking seriously the idea that even though we call our universe the "Universe", meaning the one thing that comprises everything, we have been wrong again and that our universe is just one of many.

Imagine a great multidimensional foam, where universes form in it like bubbles, which grow and then eventually dissipate. At the moment we know of no way to see outside our universe. However, in this foam made up of bubble universes forming and dissipating, some of the bubbles might touch. If our universe is touching another, we might be able to spot the contact point. Of course if the multiverse exists, we will wonder how it began and how it too will end. Whether such mysteries are even within the reach of our minds and imaginations will be a big issue. However, it would be great to just understand a tiny bit of it.

Venus and Mars are low in the southwest after sunset. Look for a bright, starlike object, shining steadily. Mars, much fainter, lies to Venus' left. Jupiter rises around 10pm. The Moon will be New on the 28th, and First Quarter on the 5th, in 2017.

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