

'Fine tuning' explored within a Christian understanding of reality

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We live in a remarkable 13.7 billion year old universe, on a 4.55 billion year old planet! Surprising as it may seem, it took some 10 billion years of cosmic evolution and the emergence of a vast universe for carbon-based life even to be possible. There is strong evidence that special conditions, or fine-tuning, have operated to enable a universe such as ours, containing intelligent life, to exist. This is sometimes referred to as the Anthropic Principle.

Britain's Astronomer Royal, Lord Martin Rees, some years ago published a popular monograph, *Just six numbers: the deep forces that shape the universe* (Rees 2009). The brief summary of **Rees's six numbers**, in what follows, is unavoidably somewhat technical.

- *The ratio of the electromagnetic force to the force of gravity.*
When expressed as the ratio of the electrical repulsion between two protons (the positively charged particles in atomic nuclei) divided by the gravitational attractive force between them, the ratio is approximately one followed by 36 zeros! If this number had been slightly smaller, the universe would have been short-lived and creatures would not have been able to grow larger than insects. Nor would there have been time for biological evolution to operate.
- *The strong nuclear force.*
When two deuterons (heavy hydrogen nuclei) undergo nuclear fusion in the core of a star such as the sun to make a helium nucleus, only 0.7% (or 0.007) of the total mass is converted into heat energy that powers the sun. This number, 0.007, is an indicator of how firmly atomic nuclei bind together and it sets a

limit on how long stars can live. Had the number been say 0.006 or 0.008 we could not exist.

- *The ratio of the average density of matter in the universe to the critical density recognised in cosmology.*

If this number were greater than one, the universe would have collapsed a long time ago. If it were very small, no galaxies could have formed. It means that the initial expansion of the universe must have been very finely tuned.

- *An anti-gravity effect to account for the observed accelerating expansion of the universe, first measured in 1998.*

Commenting on this, theologian Alister McGrath says

Fortunately for us (and very surprisingly to theorists), [this] is very small. Otherwise its effect would have stopped galaxies and stars from forming, and cosmic evolution would have been stifled before it could even begin.

McGrath 2009 p. 28

- *The ratio of the gravitational binding force to rest-mass energy ($E=mc^2$, where m is mass and c the speed of light).*

This is approximately 1/100,000 and is reflected in the tiny density variations observed in the background radiation from the early universe. Had this number been any smaller, the universe would have been lifeless and not very interesting. On the other hand, a larger number would have led to a universe dominated by black holes where nothing else could survive.

- *The three spatial dimension.*

Time, the 4th dimension, is different because it possesses an arrow of time.

No combination of any two or more of these six numbers has been found that can predict the value of any of the others.

McGrath's book, *A fine-tuned universe* (mentioned in point four), expands on his 2009 Gifford Lectures. He provides a theological reflection on the six numbers elaborated by Rees from within a Christian Trinitarian framework, and extends anthropic arguments to include chemistry, biology and the neurosciences. He argues that a theology of nature (or natural theology) should really be seen as a branch of theology. It is not about looking for evidence that God exists, but is about our exploration of nature within a Christian understanding of reality. Regarding St Paul's Aeropagus address in Acts 17, McGrath comments that:

Christian theology provides an interpretive framework by which nature may be 'seen' in a way that connects with the transcendent.

McGrath 1999 p. 11

In setting the stage for consideration of fine-tuning, McGrath comments:

For the theist, unsurprisingly, these observations point to the inherent potentiality with which the Creator has endowed creation...anthropic phenomena fit easily and naturally into a theistic framework, especially in Trinitarian forms.

McGrath 2009 p. 120

He argues further,

God made the cosmos with no constraining influences other than the divine will and nature.

McGrath 2009 p. 120

Or again

The observation of anthropic phenomena is...situated within a long tradition of theological and metaphysical reflection...the general phenomena of fine tuning is consonant with Christian belief in a creator God, ... [and] that the most appropriate outcome for natural theology is to demonstrate that observation of the natural world furnishes conceptual resonance with, not deductive proof of, the Christian vision of God.

McGrath 2009 p. 121

But is the anthropic principle merely a truism? The weak form of the anthropic principle, put very simply, is that we are here because we are here! The strong anthropic principle is more robust. It is the idea that the constituents of the material universe that began to emerge in the early stages after the big bang have an in-built order that leads to greater levels of structure and organisation as newer and more complex features of the universe have emerged from elementary particles, through atoms and molecules to stars, planets, galaxies and the stuff of life. The natural world is thus held to possess law-like behaviour and in science we speak in terms of laws of nature. These codify observed regularities, but don't of themselves cause things to happen! While the laws of physics are well established, laws operating at higher levels of complexity in chemistry, biology or the neurosciences are not nearly so well understood.

McGrath correctly argues that chemistry, for example, cannot be understood solely from the properties of the constituent atoms. The fact that water is liquid between 0–100°C cannot be fully predicted from the properties of the single oxygen atom and the two hydrogen atoms that constitute a water molecule. It depends in part on the particular angle between the two hydrogen-oxygen bonds and the weak bonds between the two hydrogen atoms.

In outlining the nature of fine-tuning in biology in some detail, considering the role of DNA and RNA and the remarkable role played by photosynthesis, he turns to the work of Professor Simon Conway Morris from Cambridge University who has provided much evidence from the fossil record that evolution:

...converges on a relatively small set of possible solutions for the problems and opportunities that the environment offers to life.

McGrath, 2009 p. 193

That is, there is directionality in evolution. This is consistent with anthropic arguments that appropriate constraints have operated in all aspects of the evolution of the universe.

While some physicists and cosmologists postulate the idea of multiple universes, McGrath reminds us that the only universe we know anything about is the one we inhabit. Actually he sees no problem for Christian theology in the multiverse hypothesis.

I can think of no better reason why we should seek to understand the special nature of our fine-tuned universe than the familiar words from John's Gospel — 'And the word became flesh and dwelt among us' (Jn 1:14). Our God, whom we worship, became embodied in the very material of this world!

References

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