



**MANNINGHAM**  
UNIVERSITY OF THE THIRD AGE

## U3AM at Home

### **OUR COSMIC SIGNIFICANCE: A REASON FOR OPTIMISM AMID PANDEMIC GLOOM**

Greetings, U3A members, and may this find you all, with your families, in good health and coping well with lockdown and all the problems it causes during these strange pandemic times.

Since the viral pandemic brought U3A indoor courses to a grinding halt last term, my colleague, Tony Heyes, has organised Zoom meetings on Wednesdays, for us to continue our course (Astronomy, Physics and Cosmology). We present for discussion each week aspects of our recent *cosmic perspective*, this being an OPTIMISTIC product of the mighty human mind at its best, up there with fine music and art and great literature; no less than an unfolding comprehension of the Universe and our place, our *cosmic significance*, within it ... a perspective now diffusing into global human consciousness, into Freeman Dyson's *world soul*. It has the potential to assist, to reinforce, all the social reasons for cherishing our families and friends, our liberal democracy and the spirit of free enquiry which has generated it, and to promote our sharing together, cooperatively and sustainably, our instant on this, our small life-bearing world...still the only one we know, in the vastness of space and the immensity of time.

We could commence with a brief mention of the dreaded coronavirus 'blast from the remote past' causing all our problems. Here be a long single-stranded RNA (Ribose Nucleic Acid) molecule, with some 39,000 A,G,C,U bases attached, these bases encoding enough enabling genes for it to invade our mucosal cells, then parasitically and prolifically replicate to make us ill, or worse. All this is enclosed in a spiky protein envelope which has dominated the TV news for six months. But ... and here's the thing about RNA coronaviruses...we think their ancestry goes all the way back four billion years to a primeval RNA world and the origin of life on Earth, when short single-stranded naked RNA molecules, bearing only a few bases, self-assembled in sites such as ocean-floor white hydrothermal (heated mineralized water) vents, then joined into longer more complex RNA molecules, swapping genes long before there were any living DNA cells to infect. And so, it would seem that an evolved complex RNA virus, very likely collected from bat droppings in a southern China cave, has come to haunt us...and to infect us...from a very remote past. You never know...?

Moving out now, from the very small nanometre viral scale to the immense scale of spacetime. In 1990, the Voyager 2 space probe, then outward bound well beyond Neptune, was commanded to look back to the distant inner worlds. It recorded a mosaic of 60 frames; slow video transmission from beyond its design range took 3 months. Our Earth entire, mistaken at first for a speck of dust to be brushed off the image, emerged from the blackness of space as a pale blue dot, a single pixel, a "dust mote suspended in a

sunbeam”, as the late Carl Sagan was moved to remark. As Sagan reminded us: on it everyone you love, every human being who ever was, every hunter and forager, every hero and coward, every creator and destroyer of civilisation, every saint and sinner in the history of our species lived there...on this dust mote; and on it we are privileged, if we so choose, to amicably share our instant together in the cosmic immensity of space and time.

What on Earth (or off Earth?) has such ‘stargazing’ to do with life and its pressures, its responsibilities? Can this cosmic perspective provide any guidance in the conduct of human affairs? Well, if we heed its indications that we humans are extremely rare, complex, self-aware, significant forms of matter, embedded within the revealed immensity of universal spacetime, possessing a brain and its output, the mind, capable of an unfolding comprehension of our status in an immense dark universe consisting mainly of simpler lifeless materials, then this perspective should reinforce social incentives to ‘sort ourselves out’, to manage our affairs with less strife, less *decibelligerence*, and to manage sustainably the resources of our good planet Earth, our only home. Additionally, we might better appreciate our Western Enlightenment-based civilisation, with its hard-won historically recent freedoms of enquiry to go whither the empirical evidence leads, unobstructed by untestable non-evidence-based orthodoxies; and its consequent achievements, including this new unifying cosmic perspective – by any standard, a major triumph of the human mind.

Present understanding endows each of us with a truly impressive cosmic pedigree: we are each an individual product of some 13.8 thousand million years of cosmic, chemical and biological evolution since the universe’s ‘inflationary big bang’ origin. A finely-tuned set of physical laws and constants have controlled the production of hydrogen and helium, followed by gravitational accretion into stars and galaxies. Then later the heavier elements forged in the fires of ancient supernovae, which have made possible planetary systems, and us handfuls of animated stardust. By chance, or necessary increase in complexity (still debated), the human brain and its output, the mind, has arisen through 4 thousand million years of Darwinian biological evolution, based on environmental natural selection of the fittest individuals and groups, commencing from archaeal viral and bacterial primeval life, here on ‘goldilocks’ Earth – a planetary rarity, with sufficient gravity to retain its gaseous atmosphere, orbiting within the habitable liquid-water zone of its long-lived stable main-sequence star.

And how have we worked all this out and continue to? Well, by the evidence-seeking experiments and observations, by the sheer persistence, the ‘blood, sweat and tears’, of scientists who have used the three-pound three-pint lump of matter we all possess in our crania, with its 100 billion nerve impulse-transmitting neurons...the most complex known matter, to date, within the observable universe. Can we ‘compress the whole of creation’ within our minds, our tiny heads? Here are a sample of recent extraordinary observations, some providing evidence supporting existing theories, and others breaking new ground:

- The first actual image of a black hole: a supermassive black hole, at the centre of the M87 giant galaxy, distant 55 million light years (one ly = 9.5 million million km).
- The discovery of planetary systems around distant suns: since most stars form accompanied by planets, it is estimated that our Galaxy, alone, has over 200 billion worlds, some potentially capable of generating life like Earth’s, based on water, carbon, and a few other cosmically common elements.
- Galactic cannibalism: common in the early universe, still occurring. Our Milky Way is ingesting a small galaxy in the Sagittarius constellation, and is gravitationally drawing in its two companion galaxies – the Large and Small Magellanic Clouds, visible on a clear dark night in the southern sky.

- The accelerating universe: driven by mysterious 'dark energy', a property of expanding spacetime, constituting about 73% of the universe, its nature being one of the really big mysteries.
- Dark matter: constituting about 23% of the observable universe, its nature also unknown, its presence visible to our telescopes by its gravitational lensing of galaxies, and by holding galaxies and clusters of galaxies together.
- The supernova zoo: a range of exploding stars, which have generated the iron in our blood, the calcium and phosphorus in our bones and teeth, the gold and diamond carbon on our ring fingers, and the 92 elements other than Big Bang hydrogen, helium and lithium.
- Einstein's predicted gravity waves: the LIGO interferometers have detected colliding black holes and neutron stars.
- Ancient life at Marble Bar: micro-filaments of ancient bacteria or algae have been found preserved in cherts 3.4 billion years old; a small sample of this red rock is on its way to Mars with the Perseverance Rover, to help calibrate its instruments searching for evidence of life in ancient Martian sediments.
- And plenty more.

It all rather makes the head spin? In the immensity of cosmic space and time, we are physically so vanishingly small ... so insignificant? On the other hand, we are the sole known life-forms who have been able to work out at least a partial idea of whence we have come, of what we are a part of ... which is no mean feat! The late Carl Sagan was among those who wonder, are we of *cosmic significance*, in a universe which has produced us after 13.8 billion years of cosmic, chemical and biological evolution: it is as though the cosmos can, in a sense, 'become self-aware' only through the agency of rare and complex forms of matter such as we are. As Stephen Hawking asked: *Who or what breathed the fire into the equations, and gives them a universe to work on?* ... a universe which, given enough time (lots!), can produce atoms, and complex assemblies of billions of atoms capable of thinking about atoms and the cosmic wonders they have produced.

And so, to all us locked-down U3A members: be of good cheer, it can't last much longer, if we can work out our inspirational cosmic perspective, then we can work out how best to deal with a @#%^&! (deleted) virus and its consequences.

With best regards,

**John O'Connor, Tutor, Astronomy, Physics & Cosmology**