Cosmic Viruses: Grand Blueprint of Life in the Universe

Chandra Wickramasinghe*[1,2,3,4], Gensuke Tokoro[1] and Predrag Slijepcevic[5]
[1]Institute for the Study of Panspermia and Astroeconomics, Gifu, Japan
[2]University of Buckingham, Buckingham, UK
[3]Centre for Astrobiology, University of Ruhuna, Matara, Sri Lanka
[4]National Institute of Fundamental, Studies, Kandy, Sri Lanka
[5]College of Health, Medicine and Life Sciences, Department of Life Sciences,
Brunel University London, UK

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ABSTRACT

There is growing evidence to support the view that viruses are not merely parasitic invaders of cells, but they contain the blueprint of all possible evolutionary outcomes, for life on Earth, as well as throughout an interconnected Universe.

Key Words: Viruses, comets, panspermia, evolution

*Corresponding author: Chandra Wickramasinghe, E-mail: ncwick@gmail.com

1. Introduction

The conventional point of view that the magnificent panorama of life on the Earth from bacteria, through plants, animals, culminating in *Homo sapiens* is the result of chance events leading to changes that fitted better either survival or prospects of better exploiting the environment. The process of random mutations selected towards achieving such a goal is where most scientists would like to end this line of inquiry at the present time. But whether this even approximates to the whole story is uncertain and has indeed been challenged in some quarters for a long time (Hoyle and Wickramasinghe, 1980). The current consensus view is further based on the premise that life must have originated here on Earth, albeit against superastronomical odds. If this position is challenged, as we think it is challenged by a vast body of evidence from diverse sources, all that rests upon it is open to doubt. Over several decades evidence for life being a cosmic phenomenon has grown to a point that to continue ignoring it is becoming a cause for serious concern (Wickramasinghe, 2010; Wickramasinghe and Tokoro, 2014).

For over 3 decades a diverse set of astronomical and geological data have provided rigorous consistency checks for life being a cosmic rather than a purely terrestrial phenomenon. The evidence

against the long held conventional viewpoint of an origin of life by a process of spontaneous generation on the Earth has mounted to the point that to ignore it is a travesty of science in our view (Wickramasinghe, 2021). The many predictions of this model from various disciplines that have been unerringly borne out in recent years is illustrated in Figure 1.

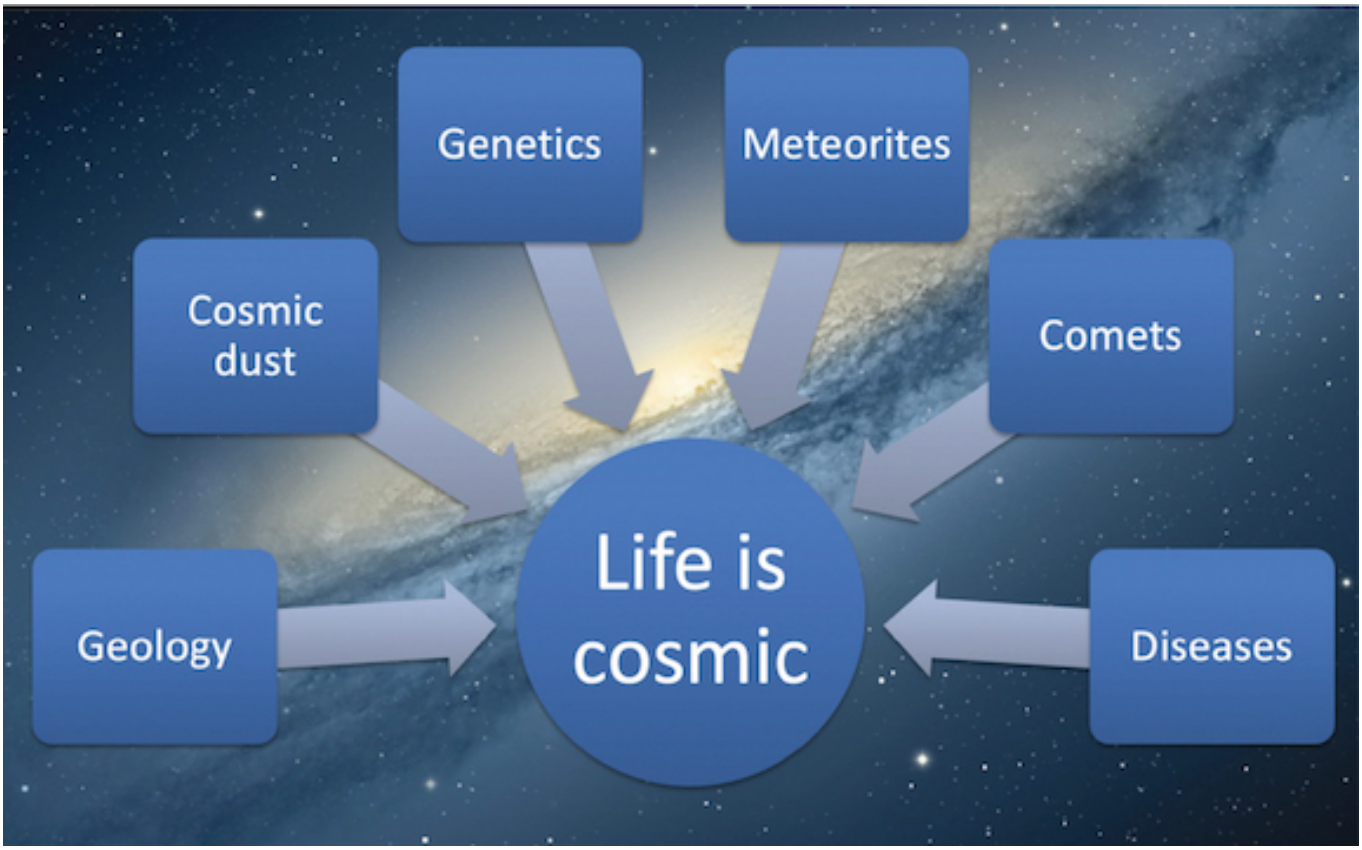

Figure 1. Lines of evidence for life being a cosmic phenomenon.

2. Viruses as drivers of evolution

There is considerable evidence to support the view that viruses can serve as drivers of the evolution of life on the Earth (reviewed in Wickramasinghe 2012). For billions of years these all-pervasive informational agents of nanometric dimensions have been largely responsible for the astounding diversity of lifeforms in our midst, from the simplest protozoa, plants and animals to ourselves – *Homo sapiens*. In earlier discussions two of us (CW and GT) have categorised these viruses by their gross function of accommodation and adaptation to their eventual planetary homes – Le and Lu. Le represents a class of virus that drives evolution in the direction of conservation within a planetary abode – exploiting the resources of a planet only to the extent of maintaining a conservative balance, and Lu representing a class

of virus that drives evolution in the direction of profligacy, leading to evolved lifeforms such as ourselves that would eventually squander a planet's resources (Wickramasinghe and Tokoro, 2014). Such an arbitrary description is possibly artificial and naïve but in our view it serves to highlight what is happening generally on planet Earth today.

The evolutionary role of viruses was predicted by one of the present authors (NCW) working in collaboration with the late Sir Fred Hoyle in 1980 (Hoyle and Wickramasinghe, 1980), four decades before gene sequencing projects got under way (Wickramasinghe, 2012). These prescient remarks from Hoyle and Wickramasinghe (1980) are worth recalling in the present context: "If viruses are incident from space then evolution must also be driven from space. How can this happen? Viruses do not always attack the cells they enter. Instead of taking over the genetic apparatus of the cell in order to replicate themselves, a viral particle may add itself placidly to one or other of the chromosomes. If this should happen for the sex cells of a species, mating between similarly infected individuals leads to a new genotype in their offspring, since the genes derived from the virus are copied together with the other genes whenever there is cell division during the growth of the offspring."

According to this point of view the relation of a planet's physical history and evolution to the lifeforms that develop upon it is only accidental in so far as it enables the expression of a cosmically determined pattern of biological evolution. An essentially infinite range of "possibilities" for evolutionary trajectories is distributed in the form of viral sequences throughout the universe ready to be assembled on habitable planets as and when appropriate conditions emerge. The analogy to trillions upon trillions of jigsaw puzzle pieces coming to be put together on habitable planets might not be far off the mark. Self-similar patterns of evolution of life would therefore be expected to expressed on every habitable Earth-like planet, of which the current estimate for our Galaxy following the Kepler telescope studies, is over 10 billion (Kopparapu, 2015).

The following statements by philosophers and thinkers before the dawn of the modern scientific age are worth recalling. In the 5th century BCE the Buddha is reported to have said the following: "As far as these suns and moons revolve, shedding their light in space, so far extends the myriad-fold world system. In it there are a myriad suns, a myraid moons, a myriad inhabited Earths and a myriad heavenly bodies. This is called the myriad-fold minor world system...." (Anguttara Nikaya). Some 2100 years later the Italian scholar Giodarno Bruno made an almost identical statement, and was burnt to death for heresy.

3. Further role of Viruses

The predominant role of viruses is at long last being slowly realised in many different ways, not

least by the global effects we have all witnessed in relation to the recent Covid-19 pandemic. It could be argued, perhaps controversially, that we are the beneficiaries as well on occasion the hapless victims of cosmic viruses. At any event it is becoming amply clear that we cannot ignore viruses as being merely a minor nuisance, but rather they might contribute to determine the direction of our lives as indeed the direction of the entire process of evolution.

Villarreal and Witzany (2021) have over many years developed the concept of virolution – virus mediated evolution – where viruses infect and colonise an already organised biological system and profoundly alter modes of "communication" within its component cells, thus leading to major functional changes. Viruses as agents that can thus transfer genetic information to organisms and effect performance is now to be regarded as a very real phenomenon.

4. Quantity of Virus on Earth

The total amount of viruses on the ground on Earth was a matter for speculation until very recently. Now a team of scientists led by Reche (2018) went to the peaks of the Sierra Nevada mountains of Spain which rise about 3500 metres above sea level and set out to collect viruses and bacteria that were falling from above the atmospheric boundary layer.

They may have expected just a trickle of viruses that were lofted by upwelling from the surface, but what they actually discovered was truly staggering. They diligently collected falling viruses that led to an estimate of some 800 million individual viruses falling every day onto every square metre of the planet. In addition, they found some 10 million bacteria falling onto every square metre per day. It is probable that a large fraction of this infall constituted viruses and bacteria that were swept into the air by sea spray and updrafts from remote urban areas, but not all of this can be dismissed so lightly. Nearly two decades earlier one of the present authors in collaboration with Harris, Hoyle, Narlikar and a team of Indian scientists detected evidence for bacteria, nanobacteria and viruses from a collection made in the stratosphere at 41km – over 10 times the height of the Sierra Nevada mountains (Harris, 2001). By remarkable coincidence our estimate from this 2001 stratospheric collection at 41km gives almost exactly the estimated of infall given nearly two decades later by Reche at al (2018) - 20-200 million bacteria per square metre per day and ten times as many viruses. This coincidence is one that we cannot easily dismiss.

5. A cosmic virosphere and Shanon information

In a recent paper two of us (Slijepcivic and Wickramasinghe, 2020) discussed the possible role of a cosmic virosphere interacting with our planet which is all the more relevant in the light of recent

developments. We pointed out that the total genomic content of our entire planet is numerically dominated by viruses, a situation that is unlikely if viruses are merely a breakdown product of cellular life forms. Epifluorescence microscopy of sea water has recently shown the existence of ~ 10 million virions in a single drop of ocean water, ~ 10^{10} virions per litre or 10^{31} virions throughout the oceans. It now seems certain that these viruses are being constantly resupplied through infall from the atmosphere (Reche et al, 2018) which in turn, in our view, most probably came from space. There is a tendency to dismiss all these results as due to contamination from the Earth itself, but this is largely based on the prejudice against our view that the Earth is connected to a wider cosmic biosphere and virosphere. The idea of a population of cosmic viruses in control of all life on Earth and perhaps in the universe is not one to which we have been accustomed.

The Shannon information content in the genome of a relatively simple virus, e.g. the Corona virus (Covid 19) has been estimated at ~ 7.5kbytes, whereas the information content in the human haploid genome is estimated at about 3,44 Gbytes = 3.44×10^6 kilobytes. It is clear that we do not require a vast number of viruses similar to Covid-19 to overwhelm the integrated genetic information of the entire human population. The following Table is worth noting in this context. Here we suppose that a typical virus falling in the manner described by Reche et al (2018) has a notional genome containing 10 kilobytes of Shannon information (Covid19 has an estimated 7.5kbytes and the human genome has an information content of say 3 million kilobytes).

Even if only the minutest fraction of incoming Shannon information from viral ingress succeeds in affecting humans through a microbiome overlap or disease the message from Table 1 is clear: viruses play an important role in the evolution of all life on Earth not excluding humans.

Figure 2 show striking comparison between epifluorescence detections of viruses in a single drop of ocean water (Left) and a section of the deep-field Hubble survey of galaxies (Right). A hundred million virions in a drop of seawater should be compared with a roughly comparable number of galaxies in every square degree of the night sky. The overwhelming control of viruses in the universe is again emphasised by means of this comparison.

Table 1

Viruses falling from skies over the whole Earth's surface per year:	1.44×10^{27}
Shannon information ingress rate from infalling viruses:	**1.44×10^{28} kbytes/yr**
Shannon information content of entire human population of 8 billion:	2.4×10^{16} kbytes
Replacement rate with mean life expectancy of 70 years:	**3.4×10^{14} kbytes/yr**

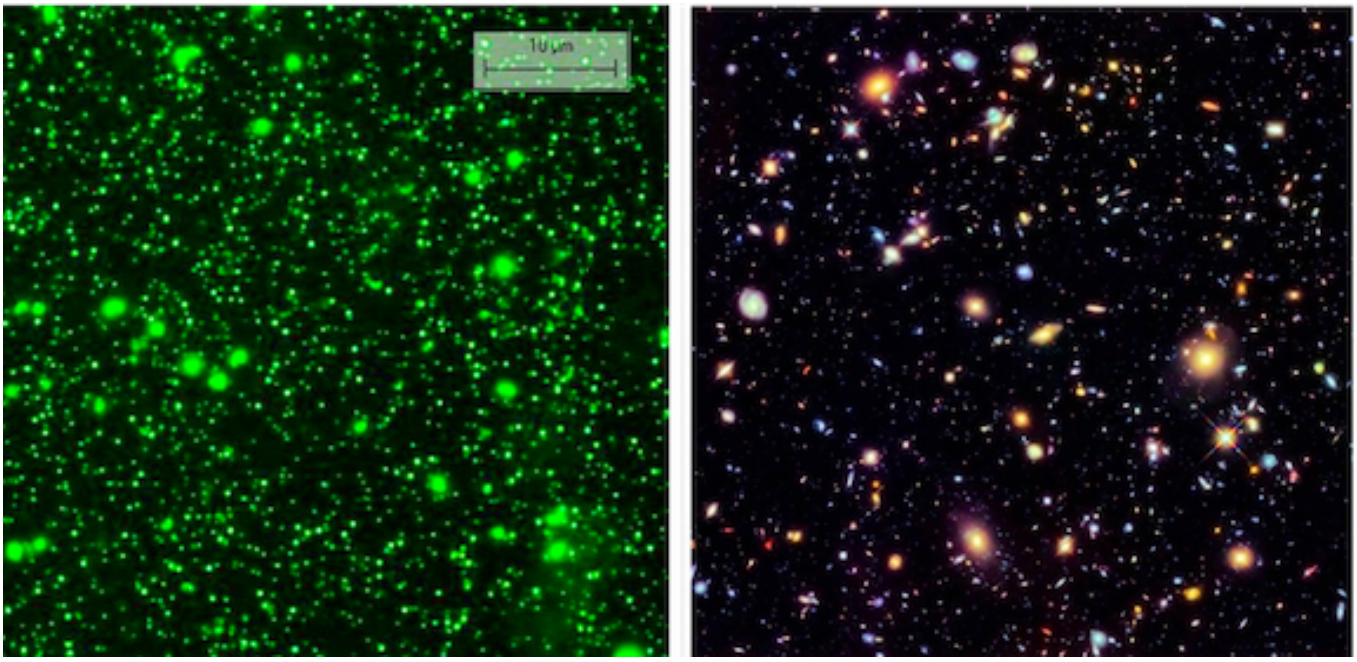

Figure 2. Epiflourescence detections of virions in a drop of ocean surface water compared with a section of the Hubble deep field imaging of galaxies.

6. Viruses and SETI

It is also becoming ever more certain that bacteria and viruses play a central role in the functioning of all higher life including humans (Wickramasinghe, Nimalasuriya, Wainwright and Tokoro, 2015). Bacteria and viruses are vitally important to everything from our immune system to the microbiome in our gut. They also play a controlling role in all ecosystems both on land and sea. Viruses contain a vast component of unknown genes — and they spread them to other species. To identify this unknown viral component and to accept its cosmic provenance is crucial for any sensible progress in understanding biology – to say nothing of our place as living creatures in the vast cosmos. In a recent paper in collaboration with R. Temple, the present authors have considered the possibility of external civilizations using viral genomes as coded "messages" to be decoded, or as a means to effect changes in behaviour of the dominant species on the Earth – a deliberate extraterrestrial colonisation by the use of viral vectors distributed and scattered throughout the cosmos! (Wickramasinghe, Tokoro and Temple, 2021). In a separate paper two of us have pointed out that the failure of SETI may well be due to this lack of attention to the transmission of viral and bacterial messages (Slijepcivic and Wickramasinghe, 2020)

Finally, we note that a recent possibly controversial paper Vana (2020) has concluded that the human brain is not merely a vehicle responsible for emergence of consciousness but it is in fact of a brain-gut-microbiome interactive system. Whether we agree with this conclusion or not, Vana clearly

highlights the importance of studying the role of symbiotic bacteria viruses for the study of our consciousness. If life is accepted as a cosmic phenomenon consciousness may well be thought of as an emergent property caused by a two-way communication between the brain (as an organ) and gut microbiota which may be continually replenished from an extraterrestrial cosmic environment.

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