Cometary panspermia

A radical theory of life's cosmic origin and evolution

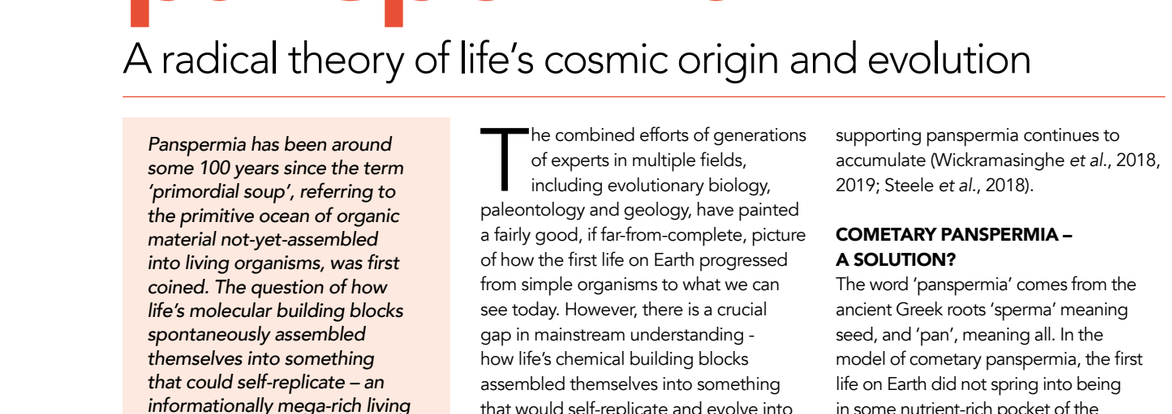
Panspermia has been around some 100 years since the term 'primordial soup', referring to the primitive ocean of organic material not-yet-assembled into living organisms, was first coined. The question of how life's molecular building blocks spontaneously assembled themselves into something that could self-replicate – an informationally mega-rich living organism – remains unanswered. Meanwhile Chandra Wickramasinghe and his team of international collaborators have been arguing that the seeds of all life (bacteria and viruses) may instead have arrived on Earth from space, and may indeed still be raining down to affect life on Earth today, a concept known as cometary panspermia.

The combined efforts of generations of experts in multiple fields, including evolutionary biology, paleontology and geology, have painted a fairly good, if far-from-complete, picture of how the first life on Earth progressed from simple organisms to what we can see today. However, there is a crucial gap in mainstream understanding - how life's chemical building blocks assembled themselves into something that would self-replicate and evolve into the magnificent panorama of life on our planet. After decades of research and experimentation, no one has yet been able to produce or propose a firm mechanism by which life could spontaneously emerge from inanimate material. Proponents of a theory called cometary panspermia argue that the speed at which life emerged on Earth, combined with the exceedingly long odds of the random assembly of self-replicating molecules, would make the spontaneous appearance of life on Earth nothing short of miraculous (Hoyle and Wickramasinghe, 1982, 2000). Meanwhile a diverse range of scientific evidence supporting panspermia continues to accumulate (Wickramasinghe *et al.*, 2018, 2019; Steele *et al.*, 2018).

COMETARY PANSPERMIA – A SOLUTION?

The word 'panspermia' comes from the ancient Greek roots 'sperma' meaning seed, and 'pan', meaning all. In the model of cometary panspermia, the first life on Earth did not spring into being in some nutrient-rich pocket of the ocean, but arrived on Earth from comets. Furthermore, it wasn't a single, special, comet that brought life to Earth - rather, the cosmos is awash with life in the form of bacteria and viruses. These microbes are stored and nurtured in comets and planets and are present in interstellar dust clouds.

This idea sounds utterly out of place alongside common conceptions of Earth as the only known refuge for life in an otherwise barren and hostile cosmos. Wickramansinghe argues that panspermia not only goes against the prevailing scientific doctrines regarding life, but ingrained, long-term western cultural conceptions of life dating back to the ideas of Aristotle, and that this may be the source of some of the more hostile resistance the idea of panspermia commonly evokes. If and when the concept is conceded it will surely rank among the most important breakthroughs in over a century.



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…And over 450 articles, ~ 60 in *Nature*

Prof Wickramasinghe argues that the seeds of all life (bacteria and viruses) may have arrived on Earth from space, and may indeed still be raining down to affect life on Earth today, a concept known as cometary panspermia.

BUT HOW CAN LIFE SURVIVE IN SPACE?

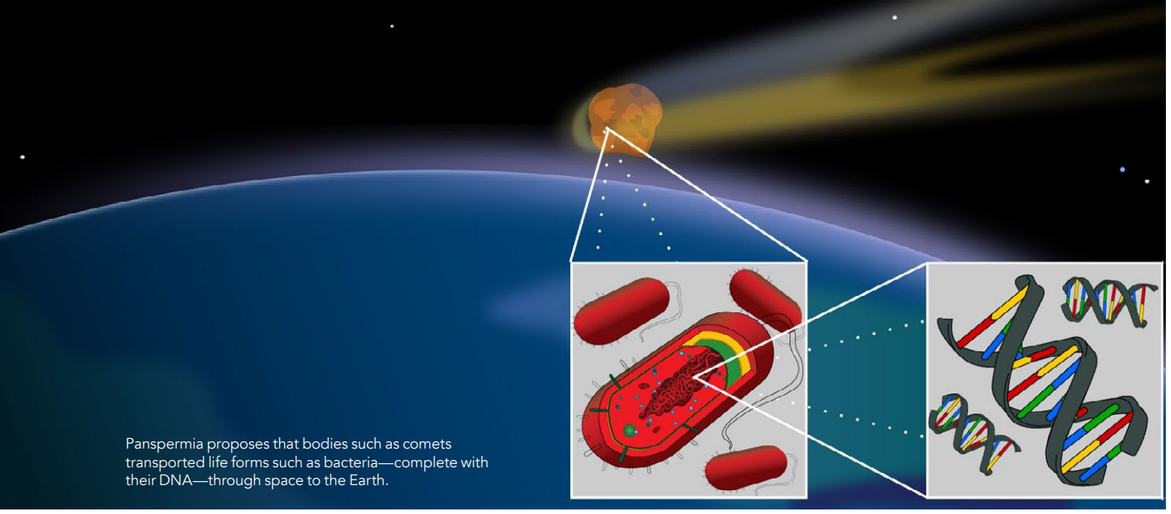
In the theory of cometary panspermia, comets are carriers of life, providing a stable vehicle to transport bacteria and viruses across space, between cosmic dust clouds and star systems. With the recent observations of two comets visiting our solar system from elsewhere ('Oumouma and Comet Borisov), we can see that galactic wanderers are normal features of the cosmos. Comets are known to have significant water content as well as organics, and their cores, kept warm by natural radioactivity, are argued by Wickramasinghe to contain pockets of liquid water for microbes to survive in (Hoyle and Wickramasinghe, 1985).

The Earth is then just another habitat amongst many trillions in the cosmos, where the cosmic legacy of life is nourished and can thrive.

Bacteria have been found able to survive on the outside of the International Space Station (Grebennikova, T.V., *et al.* 2018). Wickramasinghe and Rycroft (2018) have argued that these could not have been lofted from the Earth to a height of 400km by any known process. Bacteria have also been found high in the stratosphere, residing naturally up to 41km above Earth's surface (Harris *et al.* 2002; Wainwright *et al.* 2004). Microbial communities have been found surviving after 100 million years buried under ocean sediment (Morono *et al.* 2020). The observed ability of life to survive in hostile conditions, or lie close-to-dormant for millions of years and emerge to create healthy populations, lends some credence to the idea of cosmic comet-bound travel.

But comets are still bleak, barren objects fully exposed to the intense radioactive

At the Institute of Oriental Philosophy, Tokyo.



Panspermia proposes that bodies such as comets transported life forms such as bacteria—complete with their DNA—through space to the Earth.

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bombardment and temperature extremes of space. Is it really possible that organisms ferried on comets would be able to seed a planet after tens of millions of years in transit? Survival may indeed be possible in the protected deep interiors of comets, but what of survival once living cells leave the comets?

The harsh environment of space may indeed wipe out the vast majority of any iterant life, but life is, by definition, good at surviving and replicating exponentially. If only a few viable microbes, of an initial population of trillions, survive the transit between viable planets, then these comet-borne microbes could be the seeds of life on multiple worlds. Indeed, transfer of life was calculated to be viable if only 1 in 10^{24} microbes survive the journey (Hoyle and Wickramasinghe, 2000). Wickramasinghe uses the analogy of seeds scattered in the wind - only a few will take root and survive to adulthood, but they will then be able to produce thousands more seeds, and continue the cycle.

In the theory of cometary panspermia, life resides on countless planets and in dust clouds, riding between viable habitats on comets. The Earth is then just another "island" habitat, one amongst many trillions in the cosmos, where life could be nurtured and can thrive uninterrupted for billions of years.

AND IS ALIEN LIFE STILL ARRIVING NOW?

If life was present throughout the cosmos, and it was through cometary dust that life arrived on Earth, then surely it would still be raining down on Earth. Wickramasinghe believes this to be the case.

As mentioned previously, life has been found by high altitude balloons flown into the stratosphere (Harris *et al*. 2002). One possible explanation as to how these bacteria got there is strong winds blowing them up from the surface. However, Wickramasinghe asserts that this is not possible and they may in fact be raining down directly from space, at the prolific rate of tonnes of microbes per day over the whole Earth (Wainwright *et al*. 2004, Wickramasinghe *et al*. 2020).

If this is indeed the case, and Earth will be subject to a constant rain of alien microbes, it stands to reason that we should be able to detect alien genomes by sequencing wild bacteria. However, the amount that could be raining down would be miniscule compared to what already lies on Earth's biologically rich surface, and would be exceedingly hard to detect. As such, Wickramansinghe strongly advocates for further study of microbes found in the high atmosphere, arguing that the genetics of microbes collected in the high atmosphere, and any success or failure to detect alien DNA, could be sufficient to prove or disprove panspermia.

Wickramansinghe believes that this rich source of genetic information, including viruses, raining down constantly, may have strongly influenced (and continues to influence) evolutionary development on Earth (Hoyle and Wickramasinghe, 1982; Wickramasinghe, 2013). Indeed, in a 2018 paper, the unique features and rapid evolution of octopi were argued to be taken as signals of the presence of alien DNA (Steele *et al*. 2018). Pandemics of viral disease throughout history and even now may well have a cometary provenance according to Wickramasinghe (Hoyle and Wickramasinghe, 1979, Qu and Wickramasinghe, 2020, Steele *et al*. 2020).

THE FUTURE OF PANSPERMIA

The theory of panspermia and its profound implications have attracted sustained, strong often irrational rebukes from multiple scientific disciplines ranging from astrophysics to genetics to epidemiology. However, its champions, like Chandra Wickramansinghe, remain undaunted supporters maintaining that evidence is all that matters, and the evidence is in their favour.

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Wickramasinghe has asked if our ongoing attempts at space exploration, including SETI (the search for extraterrestrial intelligence), are truly the first steps for humanity to discover its place in the universe, or perhaps they reflect the expression of an innate knowledge that we are indeed part of a vast cosmic community of life (Slijepcivic and Wickramasinghe, 2021). If this were true, it would surely inspire a great change in our understanding of ourselves and our relationship with the cosmos. Wickramasinghe firmly believes that this is the case. Only time will tell.

Behind the Research

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Research Objectives

Professor Chandra Wickramasinghe has made ground-breaking contributions to exploring the nature of cosmic dust, its role in astrophysics, and its relevance to the understanding of life in the Universe.

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Detail

Bio

Professor Nalin Chandra Wickramasinghe was born in Sri Lanka and educated at Royal College, Colombo and later at the University of Ceylon. In 1960 he obtained a First Class Honours degree in Mathematics and won a Commonwealth scholarship to Trinity College Cambridge. He commenced work in Cambridge on his PhD degree under the supervision of the late Sir Fred Hoyle, and published his first scientific paper in 1961. He was awarded a PhD degree in 1963, ScD degree in 1973, and was a Fellow of Jesus College Cambridge from 1963–1973. He was also a Staff Member of the Institute of Astronomy at the University of Cambridge over the same period. Here he began his pioneering work on the nature of Interstellar Dust, publishing many papers in this field that led to important paradigm shifts in astronomy. He was a Professor at University College Cardiff and Cardiff University from 1974–2011. He has held visiting Professorial appointments in the US, Canada and Japan and Sri Lanka at various times. In 1983/84 he was Science Advisor to the President of Sri Lanka and Founder Director of the Institute of Fundamental Studies in Sri Lanka. He is currently Honorary Professor at the University of Buckingham, UK, University of Ruhuna, Sri Lanka and an Adjunct Professor at the National Institute of Fundamental Research in Sri Lanka.

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Collaborators

Dayal Wickramasinghe, Max K. Wallis, Christopher Tout, Gensuke Tokoro Edward J. Steele, Robert Temple, Predrag Slijepcevic and numerous others.

Personal Response

We know that the Universe has a finite age, so life too must have had a beginning. Panspermia can explain how life came to Earth, but how could it solve the problem of the origin of life in the Universe?

"Attempts to prove the rival theory of Earth-centred abiogenesis that have continued for well over half a century have led to failure thus far, and our assessment of the super-astronomical improbability of a simple living system arising from non-life gives little hope of this being ever proved. On the other hand, the theory of cometary panspermia first discussed by the late Sir Fred Hoyle and myself in 1980, continues to yield an unbroken astounding record of correspondences of its predictions to new data and new observations. I maintain that wrong theories do not show up in such a way. Over a period of four decades there have been ample opportunities for "disproof" of the theory in a Popperian sense. This has not happened. I think it is time that the veil of cultural prejudice that impedes the acceptance of facts is lifted once and for all."