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Cosmicrobia: A New Designation for the Theory of Cosmic Life

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Abstract

The common belief is that the present author and Fred Hoyle in the late 1970's embarked on a programme of work to revive the discredited, two and a half millennia-old, theory of panspermia on a whim. In this article I attempt to clear up this misconception and show that we were guided inexorably toward such a goal as a flood of new supporting data came to light from astronomy, geology as well as biology. This is an important record to set right as evidence continues to grow in the direction of supporting the theory of life being a cosmic phenomenon.

Keywords: Cosmic life, panspermia, cosmicrobia

1. Introduction

It does not require much ingenuity to observe that the prevailing theory of spontaneous generation of life on Earth lacks any compelling body of empirical fact to prove it, nor indeed support it in any significant way. Ever since Charles Darwin's *Origins of Species* was published, the much publicised "evidence" for spontaneous generation appears to be based on Darwin's letter to Joseph Hooker in 1871:

"But if (and oh what a big if) we could conceive in some warm little pond with all sorts of ammonia and phosphoric salts, light, heat, electricity etcetera present, that a protein compound was chemically formed, ready to undergo still more complex changes…. "

It was taken for granted that such a process of chemical evolution with an end directed to biology had of necessity to precede the processes of biological evolution that Darwin discussed extensively in his "*Origins of Species*" in 1959 (1). However, this does not follow logically, and the detailed processes by which it could happen in chemistry continues elude scientists.

2. Improbability argument

The operation of a living system depends upon many thousands of chemical reactions taking place within a membrane-bound cellular structure – namely a biological cell. Such reactions, determined ultimately by the order of nucleotides in DNA, are grouped into metabolic pathways that have the ability to harness chemical energy from the surrounding medium. This takes place through a series of very small steps transporting molecules into cells, building up long-chain biopolymers, and ultimately making copies of themselves. Batteries of enzymes, comprised of long chains of amino acids, play a crucial role as catalysts precisely controlling the rates of chemical reactions that ensure the proper working of the cells. In the absence of enzymes, and the exceedingly specific arrangements of amino acids within the enzymes, that are in turn coded through DNA, there could be no life (2,3).

In present-day biology, the precise "information" contained in enzymes—the arrangements of amino acids into folded chains—is transmitted by way of the coded ordering of the four nucleotides (A,T,G,C) in DNA. In a hypothetical RNA world, that some biologists think may have predated the DNA-protein world, RNA is argued to serve a dual role - as both enzyme and transmitter of genetic information. If a few such ribozymes are regarded as precursors to all life, one could attempt to make an estimate of the probability of the assembly of a simple ribozyme composed of 300 bases. This probability turns out to be 1 in 4^{300}, which is equivalent to 1 in 10^{180}, which can hardly be supposed to happen even once in the entire 13.9-billion-year history of a conventional Big Bang universe. And this is just for a single enzyme. For the totality of enzymes needed for the functioning of the simplest cell, the "Shannon" probability resources are mind-blowing to say the least. Our much publicised and criticised analogy of a tornado blowing through a junk yard leading to the assembly of a fully functioning aircraft remains as valid a comparison today as it was when Fred Hoyle first used it in a lecture to illustrate the absurdity of the proposition inherent in the theory of spontaneous generation.

3. Spreading life through the Galaxy

Besides deep-frozen cometary bodies with radioactively heated interior domains that serve as the long-term reservoirs of cosmic microbial life, freeze-dried bacteria often encased within larger particulates could be distributed on a galactic or even extragalactic scale. Introduction of such "life seeds" to planets on which life has already taken root, can also serve to spread the genetic products of the evolution of life by "horizontal gene transfer" through the Galaxy. Such a process is well attested to take place for the transport of genetic information between species of plants and animals on Earth (4) and may easily be extended to apply on a galaxy-wide scale (5).

Our own solar system, where life has existed for the past 4.2 billion years moves around the centre of the Galaxy in an orbit that is completed every 225-250 million years. In its course, gravitational interactions with nearby molecular clouds inevitably leads to perturbations of the Oort cloud of comets that surrounds our solar system causing episodes of impacts onto the Earth of life (microbe) bearing comets. In addition, dormant microbes securely preserved within clumps of interstellar dust many also be introduced from interstellar dust clouds exterior to the solar system.

The overwhelming weight of evidence favours the survival of bacteria under interstellar conditions, at any rate to the extent that makes viable interstellar transfers of microbial life between star systems inevitable. We do not require more than one in ~10^{24} iterant microorganisms to survive, until it becomes incorporated in a planet/comet forming event by which a new cycle of exponential amplification occurs. The strong feedback loop of cosmic biology depicted in **Fig.1** can account for all the astronomical data that relates to organic molecules in space.

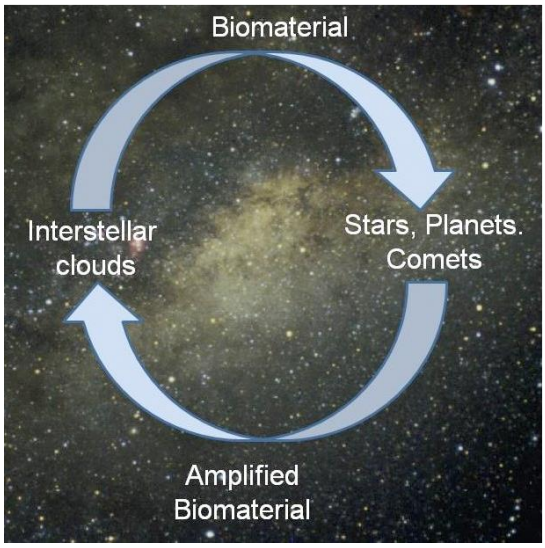

Fig.1: Bacteria and viruses expelled from a planetary system are amplified in the warm radioactively heated interiors of comets and thrown back into interstellar space, where a fraction breaks up into molecular fragments that are observed, but a non-negligible minute fraction remains viable.

The exceedingly modest requirement of microbial survival of 1 in ~10^{24} would be well-nigh impossible to violate particularly for freeze-dried microorganisms embedded within clumps of interstellar dust. This expectation has been borne out in a long series of investigations that have been conducted in the laboratory, in space, on Mars, and from the 1970's to the present day (6,7,8). In one example, the survival of colonies of *Deinococcus radiodurans* on the exterior of the international space station (ISS) for over 3 years led to surprise with a reluctant admission by the investigators that microbial life may indeed be easily transferable between distant habitats in the Galaxy.

The vast majority of bacteria in interstellar space do not and need not persist in a viable state, however. Viruses (which carry coded information in the form of DNA or RNA), compared to bacteria, have smaller target areas for cosmic-ray damage and will therefore be expected to have a relatively longer persistence in interstellar space. And both bacteria and viruses within hard-frozen interiors of comets would have an almost indefinite persistence, and for this reason comets in our theory serve as long-term cosmic reservoirs of life. Interstellar clouds which would be filled overwhelmingly with the detritus of life escaping from planetary systems as well as comets will naturally include a wide range of organic molecules as has indeed been observed over the past four decades. However, attempts to discover the roots of abiogenesis in interstellar clouds, as is currently fashionable, are manifestly futile in my view (7).

Besides the well-attested space survival properties of bacteria and viruses that are now well attested, several independent lines of evidence for the concept of life as a cosmic phenomenon have be discussed at length elsewhere (8, 9, 10, 11) and does not need further discussion. Stratospheric sampling experiments from a height of over 40 km have consistently led to positive detections of in-falling microbiota, and from samples collected in a measured volume of the stratosphere at 41km we can deduce an average in-fall rate over the whole Earth of 0.3-3 tonnes of microbes per day (12,13,14,15). This converts to some 20-200 million bacteria per square metre arriving from space every single day.

Between 2001 and the present day, this average in-fall rate of microbiota has been been amply confirmed, although it is not still widely admitted. Moreover, a crucial test to confirm their extraterrestrial origin requires access to a *Nanosims* machine to determine isotope information, and such equipment has not been made available. Recently it has also been confirmed that the exterior of the International Space Station (ISS) has deposits of bacteria which are difficult to dismiss as terrestrial contaminants (16,17). At the present time (2023) a vast body of astronomical and biological evidence continues to point to life being a cosmic phenomenon, but such evidence tends to be ignored. A paradigm shift from Earth-centred life to cosmic centred life is now long overdue, but this has been blocked persistently for reasons that are more connected with history, sociology and science politics, rather than with science itself.

4. Historical constraints and need for new name

The history of panspermia in Western philosophical tradition dates back to the pre-Socratic Greek philosopher Anaxagoras of Clazomenae (500-428 BCE). The outright rejection of panspermia by Aristotle two centuries later sealed the fate of panspermia by placing Aristotle's theory of the Spontaneous Generation of life on an almost sacred footing. Even though evidence against the validity of spontaneous generation was sporadically offered throughout succeeding centuries, a basically Aristotelean dogma has stubbornly prevailed. Every alleged "disproof" of panspermia was hailed as a triumph for orthodox scientific wisdom. The term panspermia itself, in the author's view, came to be inextricably linked to rebellion, heresy and non-conformist science. There is an urgent need to deploy a new word that encapsulates the concept of life as a cosmic phenomenon with its informational components (bacteria and viruses) distributed throughout the cosmos.

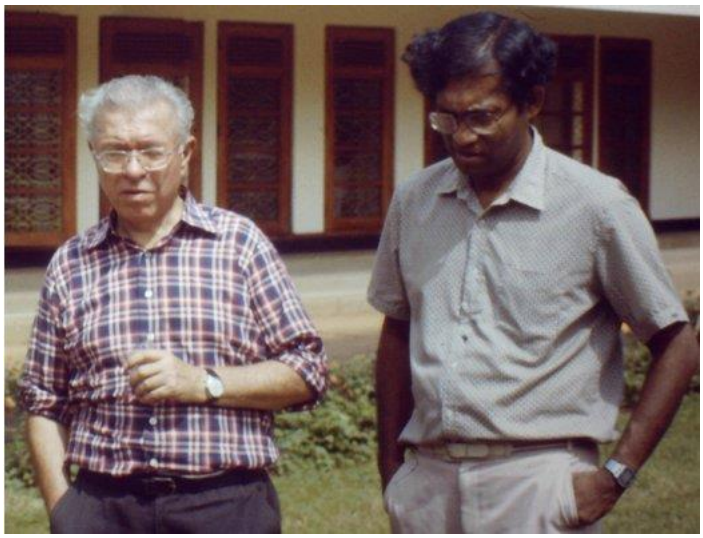

Fig.2: Fred Hoyle and Chandra Wickramasinghe at the National Institute of Fundamental Studies, Sri Lanka (Photo 1982)

When evidence for life being a cosmic phenomenon began to accumulate from the early 1980's, Fred Hoyle and the present author agonised over the question of terminology. What do well call this emerging world view? How could we communicate the essence of the new ideas to the scientific community and the wider public? Our attempts to answer such questions led us to contemplate the naming of a new emerging scientific discipline in its own right

In 1981 in the book "Space Travellers: The Bringers of Life" Hoyle and the present author (18) concluded thus:

"For a generation or more astronomers have been accustomed to thinking of star-forming episodes accompanied by the production of vast clouds of interstellar grains. The episodes are sometimes local but they are often galaxy-wide. They are thought to be triggered by some large-scale event, the after effects of which linger on for some considerable time, several hundred million years. The condensation of the exceptionally bright stars which delineate the spiral structures of galaxies has often been associated with these episodes. From our argument it seems then that even the origin of the spiral structures of galaxies may well be biological in its nature.

The potential of bacteria to increase vastly in their number is enormous. It should occasion no surprise, therefore, that bacteria are widespread throughout astronomy. Rather would it be astonishing if biological evolution had been achieved on the Earth alone, without the explosive consequences of such a miracle ever being permitted to emerge into the Universe at large. How would the Universe ever be protected from such a devasting development? This indeed be a double miracle, first of origin, and second of terrestrial confinement.

Some biologists have probably found themselves in opposition to our arguments for the proprietary reason that it seemed as if an attempt were being made to swallow up biology into astronomy. Their ranks may now be joined by those astronomers who see from these

last developments that a more realistic threat is to swallow up astronomy into biology. The reality may be the birth of a new scientific disciple astrobiology."

These statements, as far as we can see represent the first documented introduction of astrobiology into the scientific arena and the start of an inevitable merger of astronomy and biology (19).

Another question that we pondered at this time related to nomenclature - the term appropriate for the concept of viable microbial life being transferred across astronomical distances. We were fully aware of the genesis of the term *Panspermia* and of his fateful history throughout the Christian era extending into modern times (Wainwright and Wickramasinghe, (20)). The frequent denials and the alleged *disproofs* of panspermia that punctated history over centuries should have signalled caution in relation to its use in the 20th century, but unwisely we adopted it perhaps *protem,* not realising the impediments that are inherent in attempting to revisit an abandoned idea. In 1997 Fred Hoyle and the present author published the book "Life on Mars? The case for a cosmic heritage?" (21) in which we made the following statement:

"The name panspermia was in our opinion ill-chosen and has probably done more to turn people off the concepts to which the name is currently applied than anything else. A better name is urgently needed. Even the crude *bugs from space* appellation is better (BFS). We might also suggest the term *Cosmicrobia* for consideration, a word that combines both cosmic and microbial meanings…."

Even belatedly I think we should now begin to use the word *Cosmicrobia* in place of *Panspermia* for the suite of ideas and results that now strongly supports the concept of life being a cosmic/cosmological phenomenon. This would be free of the stigma attached to the word *panspermia*, and might serve to herald a new beginning, thus laying a secure foundation on which future generations can build.

To conclude I will remark that signs of imminent change - a major paradigm shift from Earth centred life to life as a cosmic phenomenon - have come from many different directions and is now virtually unavoidable (22,23). The crucial data to clinch this shift must come from the results of experiments such as we have discussed here involving the recovery of microbes of space origin, and by establishing such an origin beyond a shadow of doubt. Besides the methods deployed thus far, isotope analyses of microbes recovered before they are cultured possibly deploying Nanosims equipment. In this way we would conclude that the evolution of life takes place not just within a closed biosphere on our minuscule planet Earth but extends over a vast and connected volume of the cosmos. The consequences of embracing this new paradigm will be far reaching and profound.

Postscript

A recently reported discovery adds significantly to the case in support of cosmicrobia (https://www.space.com/james-webb-space-telescope-exoplanet-atmosphere-carbon-dioxide-methane). The exoplanet K2-18 b is a "super-Earth" orbiting an M-type star with a mass of nearly 9 Earth Masses. It has an orbital period of 32.9 days around its central star at

an orbital distance of 0.14AU. The star and planet are located at a distance of some 38 parsecs (124 light years) from our solar system of 38 parsecs from our own solar system.

Recently NASA's James Web Telescope reported the tentative discovery on this planet of a chemical compound that is exclusive to terrestrial biology – dimethyl sulphide (DMS) - along with carbon dioxide & methane in its atmosphere. These discoveries are very strongly suggestive of extraterrestrial life. The implication is that life either originated independently on K2-18b, against impossible odds, and followed the same evolutionary path as it did on the Earth - against doubly or trebly impossible odds – or, life is a cosmic phenomenon. The choice is as stark as it is remarkable and revealing. The new discovery, if confirmed, shows the absolute validity of panspermia, or cosmicrobia, exactly as proposed by Fred Hoyle and Chandra Wickramasinghe in the 1980's for which evidence has continued to grow up to the present day.

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